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Mathematics 5

2-D Shapes and 3-D Objects

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Mathematics 5
Module 9: 2-D Shapes and 3-D Objects
Student Module Booklet
Learning Technologies Branch
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Students	✓
Teachers	✓
Administrators	
Home Instructors	
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Other	

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Welcome Aboard
Mathematics 5

Ahoy! Mathematics 5 contains nine modules.
You should work through the modules in order (from 1 to 9) because concepts and skills introduced in one module will be reinforced, extended, and applied in later modules.

Adventures on the High Seas

Kassidy: Connor, guess what? I noticed an advertisement in the newspaper. A second-hand bookshop just opened, and it's supposed to have some really old books from all over the world.

Connor: Some may even be older than our great-grandparents! Let's go take a look.

Excited about what they might find to read, Connor and Kassidy hurry off to the bookshop.

Connor: Wow! Look at this, Kassidy. Here's an actual journal kept by Captain Quinn almost 300 years ago. It's kind of musty, and parts are hard to read, but look at how much math the captain used!

Kassidy: There are also maps, descriptions of ships, and reports about sea conditions.

Connor: Let's buy it. Figuring out what the journal says will be like unravelling a mystery. Maybe it will have clues about real buried treasure.

From time to time throughout the course, you will work with many of the facts and figures about the days of sailing boats and sea captains that Kassidy and Connor discover.

Table of Contents

Course Features 8

Assessment and Feedback 10

Module Overview 11

Numbers in the News 13

Lesson 1: Identifying and Drawing 2-D Shapes 14
- Activity 1 15
- Activity 2 18
- Activity 3 21
- Challenge Activity 25
- Conclusion 26
- *Lesson 1 Assignment* 26

Lesson 2: Tangrams 27
- Activity 1 28
- Activity 2 31
- Activity 3 33
- Challenge Activity 34
- Conclusion 36
- *Lesson 2 Assignment* 36

Lesson 3: Building and Drawing 3-D Objects 37
Activity 1 38
Activity 2 41
Activity 3 44
Challenge Activity 47
Conclusion 48
Lesson 3 Assignment 48

Module Summary 49
Numbers in the News Project 49

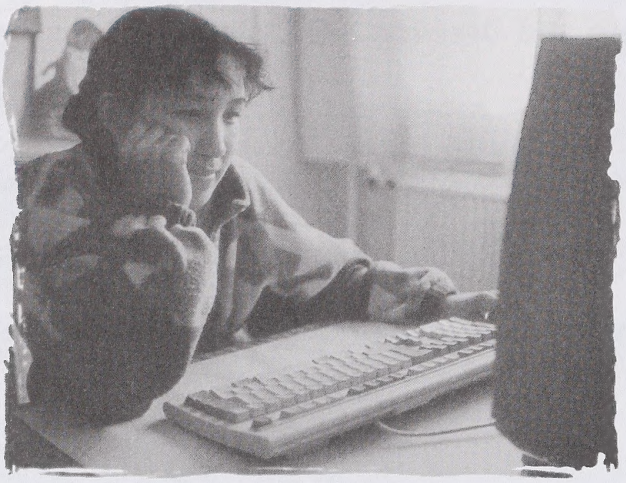
Review 50

Conclusion to Adventures on the High Seas 52

Course Survey

Appendix 55
Glossary 56
Review of Quadrilaterals 57
Answer Key 60
Image Credits 85
Cut-Out Learning Aids 87

Course Features



BRYAN AND CHERRY ALEXANDER PHOTOGRAPHY

Take the time to look through the Student Module Booklet and the Assignment Booklets and notice the following design features.

- Each module has a Module Overview, Module Summary, and Review.
- Each module has several lessons. Each lesson focuses on a big idea that is central to the topic being learned in the module.
- Each lesson has several activities. An activity in each lesson is related to the high seas adventure theme. The last activity in each lesson is a Challenge Activity.
- Each module has a Glossary and an Answer Key in the Appendix. In several modules there are also special pull-out pages in the Appendix.
- Each module has special exercises that focus on certain mathematical skills. For example, The Numbers in the News project involves a scavenger hunt for samples of math in everyday life. The Keystrokes exercise introduces some "funky features" of the calculator that can be used to explore and practise important number ideas.

Required Resources

There are no spaces provided in the Student Module Booklets for your answers. This means you will need a binder and loose-leaf paper or a notebook to do your work.

In order to complete the course, you will need a copy of the Mathematics 5 textbook, *Quest 2000: Exploring Mathematics*, the soft-cover book *Quest 2000: Exploring Mathematics: Practice and Homework Book*, a basic four-operation calculator (such as the TI-108 calculator), and various manipulatives (base ten blocks and pattern blocks).

If you wish to complete the optional computer activities, you must have access to a computer that is connected to the Internet.

Visual Cues

For your convenience, the most important mathematical rules and definitions are highlighted. Icons are also used as visual cues. Each icon tells you to do something.

Use your calculator.

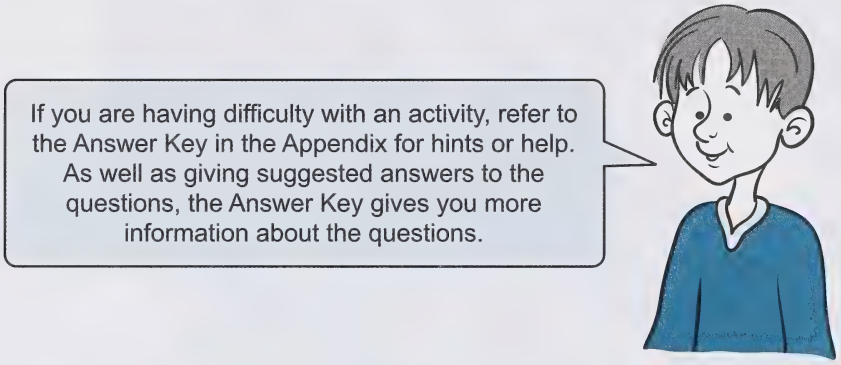
Use the Internet.

Refer to the textbook or the Practice and Homework Book.

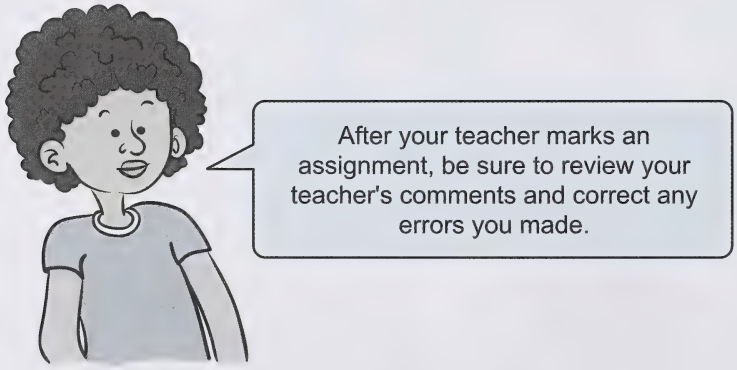
Your guides for this course are Kassidy and Connor.

Assessment and Feedback

The Mathematics 5 course is carefully designed to give you many opportunities to discover how well you are doing. In every activity you will be asked to turn to the Appendix to check your answers. Completing the activities and comparing your answers to the suggested answers in the Appendix will help you better understand math concepts, develop math skills, and improve your ability to communicate mathematically and solve problems.


If you are having difficulty with an activity, refer to the Answer Key in the Appendix for hints or help. As well as giving suggested answers to the questions, the Answer Key gives you more information about the questions.

Twice in each module you will be asked to give your teacher your completed assignments to mark. Your teacher will give you feedback on how you are doing.



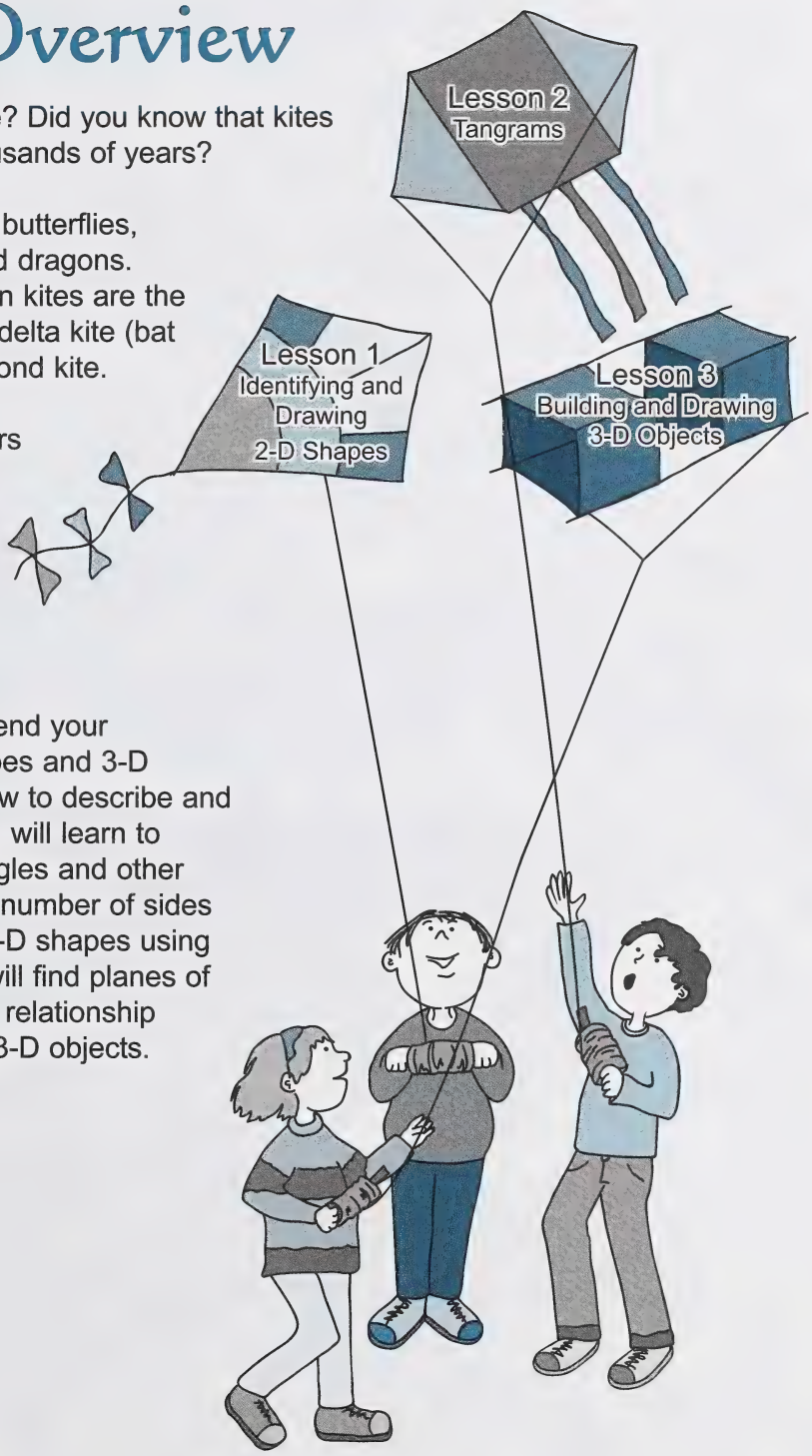
There will be a final test at the end of the course. You can prepare for the final test by completing the Review at the end of each module.

Module Overview

Have you ever flown a kite? Did you know that kites have been around for thousands of years?

Kites can be shaped liked butterflies, dragonflies, fish, birds, and dragons. Examples of more common kites are the box kite, the sled kite, the delta kite (bat kite), and the classic diamond kite. Some kites are flat, two-dimensional shapes. Others are three-dimensional objects. Kite designers use their knowledge of mathematics to create kites that are fun and attractive.

In this module you will extend your understanding of 2-D shapes and 3-D objects. You will review how to describe and classify quadrilaterals. You will learn to describe and classify triangles and other polygons according to the number of sides they have. You will draw 3-D shapes using triangular dot paper. You will find planes of symmetry and explore the relationship between 2-D shapes and 3-D objects.



Your mark on this module will be determined by how well you complete the two Assignment Booklets.

The mark distribution is as follows:

Assignment Booklet 9A

Lesson 1 Assignment	35 marks
Lesson 2 Assignment	25 marks

Assignment Booklet 9B

Lesson 3 Assignment	30 marks
Numbers in the News	10 marks
Total	100 marks

When doing the assignments, work slowly and carefully. Be sure you attempt each part of the assignments. If you are having difficulty, you may use your course materials to help you, but you must do the assignments by yourself.

You will submit Assignment Booklet 9A to your teacher before you begin Lesson 3. You will submit Assignment Booklet 9B to your teacher at the end of this module.

Numbers in the News

Numbers are everywhere! Newspapers and magazines are full of stories and advertisements that show how numbers are used every day.

The following Scavenger Hunt asks you to look through newspapers and magazines for samples of 2-D shapes and 3-D objects like those you will be using in this module. Read through the list now and begin by collecting samples of the ideas you already understand. You may collect other samples as you learn about them in the module. Collect as many samples as you wish.

Scavenger Hunt

Cut out samples of the following 2-D shapes and 3-D objects from newspapers, flyers, and magazines. Label the pictures to explain what the pictures are showing.

1. pictures showing 2-D shapes that are found and used in everyday life

    - regular and irregular polygons
    - triangles, quadrilaterals, pentagons, hexagons, octagons, and others

2. pictures showing 3-D objects that are found and used in everyday life

    - rectangular solids
    - prisms that have various polygons for bases
    - cylinders, cones, pyramids, and other objects

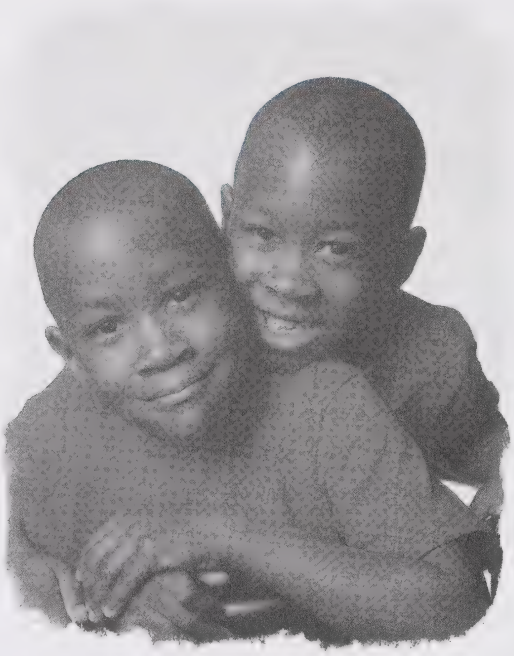
3. pictures showing 3-D objects that have at least one plane of symmetry

You will find further instructions for submitting your project in Assignment Booklet 9B.

Lesson 1

Identifying and Drawing 2-D Shapes

The boys in this photograph are twins. When three children are born at the same time, they are called triplets. *Tri* comes from the Latin word meaning "three." What words can you name that use the prefix *tri-*? Did you think of triceps (a large three-headed muscle running along the back of the upper arm), tripod (a three-legged stand for supporting a camera), triplex (a three-unit apartment building), or triangle (a three-sided shape)?



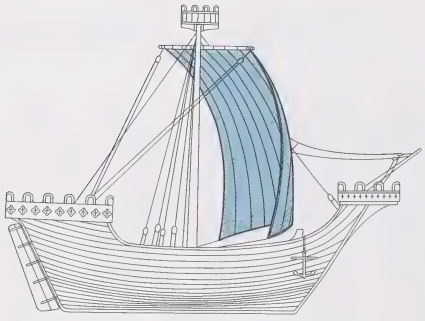
When four children are born at the same time, they are called quadruplets. *Quad* comes from the Latin word meaning "four." What words can you name that use the prefix *quad-*? Did you think of quadriceps (the large four-part muscle on the front of the thigh), quadruped (an animal with four feet), quadruplex (a four-unit apartment building), or quadrilateral (a four-sided shape)?

In this lesson you will identify and draw 2-D shapes. You will review what you know about quadrilaterals. You will extend your understanding of triangles by building, sorting, and naming them according to the number of sides. You will learn how to identify, describe, and name both irregular and regular polygons.

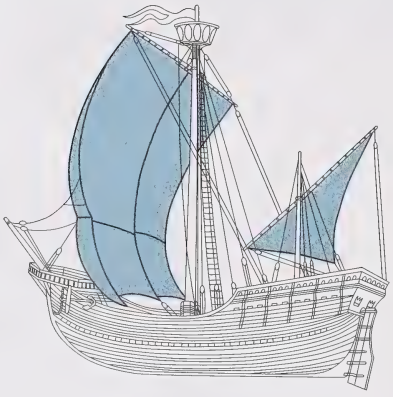
Activity 1

Today you will identify and draw quadrilaterals.

Sailing is as much an art as it is a science. People have made sailing vessels since ancient times. On the following page there are pictures of several types of sailing ships: cog, carrack, galleon, and clipper. The cogs were used from about 1250 until the early 1400s. The caravels and carracks were used in the 1400s and 1500s. The galleons were used from the 1500s to 1700s. The clippers were used in the 1800s. As ships grew larger, the number of sails increased, more masts had to be added, and the masts became taller.

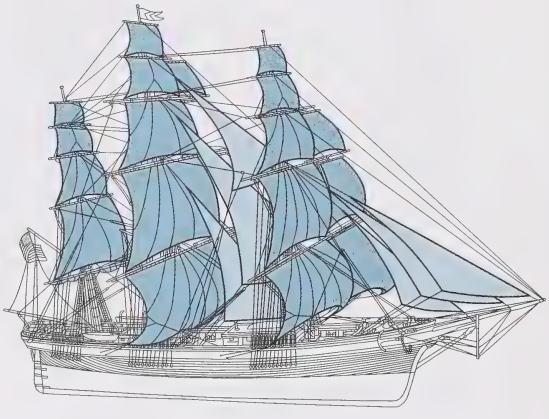


Cog



Carrack

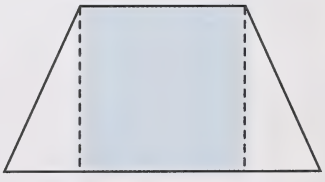
Galleon



Clipper

1. Why do you think most of the sails, especially the larger sails, on sailing ships were quadrilaterals rather than triangles?

2. Some of the sails on sailing ships were made by putting wing-like extensions onto opposite sides of a rectangular sail.



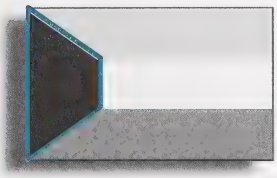
   a. What is the shape of this kind of sail?
   b. What shape is each wing-like extension?

Check your answers on page 60 in the Appendix.

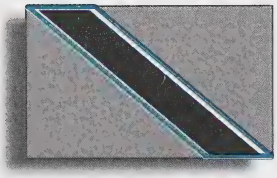
3. You can tell what country a ship comes from by the flags the ship flies. Name the outlined quadrilateral in each of the following flags. Remember to use the most specific name. (To review the types of quadrilaterals, turn to pages 57 to 59 in the Appendix.)

a.

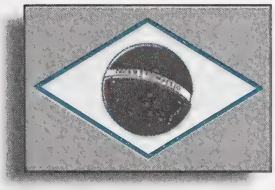
Canada

b. 

Kuwait

c. 

Trinidad and Tobago

d. 

Brazil

e.

Chile

f.

Vanuatu

Check your answers on page 60 in the Appendix.

4. Find the dot paper on page 87 in the Appendix. By joining any of the dots in a 3×3 array of dots, draw 15 **different** quadrilaterals. (**Note:** Slides, flips, and turns of a figure do **not** count as different figures.)

5. Identify each of the quadrilaterals in question 4 by their most specific name.

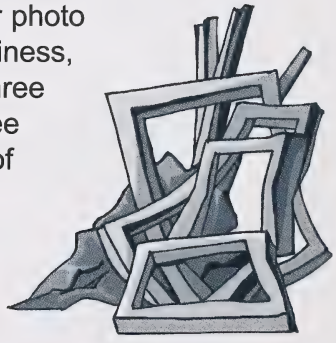
Check your answers on page 60 in the Appendix.

Activity 2

Today you will model, draw, and identify triangles.

To help you do the following questions, cut about a dozen straws of each of the following lengths: 9 cm, 15 cm, and 20 cm. You may find it helpful to use a different colour of straw for each length.

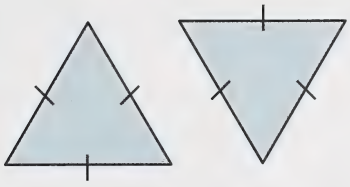
1. Kylee wanted to make triangular frames for her photo collection. Her Uncle Bernie has a framing business, and he gave her a supply of framing strips in three different lengths: 9 cm, 15 cm, and 20 cm. Kylee made every possible different size and shape of triangle using just these lengths.



Explain a strategy for using your straws to find all the possible different triangular frames that Kylee made.

Triangles that have all three sides the same length are called **equilateral** triangles.

Each of these triangles is an equilateral triangle.



The slashes indicate equal sides.

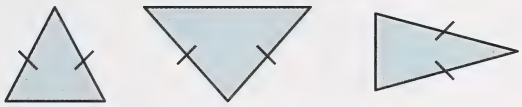
2. a. How many equilateral triangles of different size or shape are you able to make with your straws?

b. Draw pictures of the triangles you made and label the lengths of the sides.

c. What do you notice about the shape of all the equilateral triangles you can make?

Triangles that have at least two sides the same length are called **isosceles** triangles.

Each of these triangles is an isosceles triangle.



3. a. How many isosceles triangles of different size or shape are you able to make with your straws?

b. Draw pictures of the triangles you made and label the lengths of the sides.

c. What do you notice about the shape of all the isosceles triangles you can make?

d. Why is it not possible to make an isosceles triangle using two 9-cm straws and one 20-cm straw? Draw and label a picture to help you explain.

Triangles that have no sides the same length (all three sides are different lengths) are called **scalene** triangles.

Each of these triangles is an scalene triangle.

4. **a.** How many scalene triangles of different size or shape are you able to make with your straws?

   b. Draw and label a picture to help you explain how you arrived at your answer to question 4.a.

5. Pick any one of your triangles. Can you rearrange the three straws that form the triangle to change the shape of the triangle?

Check your answers on page 61 in the Appendix.

In question 5 you discovered a special property of triangles:

Given any three lengths of sides, only one size and shape of triangle is possible. This is because the sizes of the angles cannot be changed. (They are "fixed.") This is why a triangle is called a **rigid** structure.

6. Are you always able to make a triangle using any three straws, no matter what lengths they happen to be? Explain.

7. Bob and Sally were asked to design a flower garden in the shape of an isosceles triangle, with one of its sides 12 m long and another of its sides 30 m long. Bob calculated that 54 m of fencing would be needed to enclose the garden, but Sally said that was impossible!

   a. Draw a diagram to explain why Sally said it was impossible.

   b. Draw and label a diagram of what the flower garden would actually look like and find the amount of fencing needed to enclose it.

Check your answers on page 62 in the Appendix.

Activity 3

Today you will model and identify polygons.

Many traffic signs have shapes that are used worldwide. Following are examples of traffic signs:

The railway-crossing sign is a circle, but all the other traffic signs above are **polygons**.

Polygons are closed 2-D shapes having only straight sides. The prefix *poly-* means "many." The prefix of a polygon's name tells the number of sides it has.

Following are some of the most common polygons:

- A 3-sided polygon is called a **tri**angle. (The prefix **tri-** means 3.)
- A 4-sided polygon is called a **quadri**lateral. (The prefix **quadri-** means 4.)
- A 5-sided polygon is called a **penta**gon. (The prefix **penta-** means 5.)
- A 6-sided polygon is called a **hexa**gon. (The prefix **hexa-** means 6.)
- An 8-sided polygon is called an **octa**gon. (The prefix **octa-** means 8.)

1. Copy and complete the following table in your notebook to describe the traffic signs shown on the previous page.

Sign	Number of Straight Sides	Are All Sides the Same Length?	Number of Vertices	Number of Angles	Are All Angles the Same Size?	Name of Shape (based on number of sides)
Stop						
One-Way						
Highway						
Yield						
Keep Right						
School Zone						
No Exit						
Speed Limit						

2. How are the number of sides, number of vertices, and number of angles for any particular polygon related?

Check your answers on pages 62 and 63 in the Appendix.

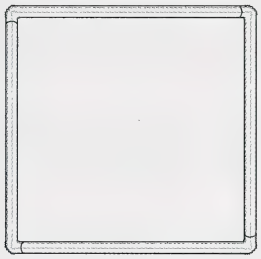
In Activity 2 you discovered the following property:

> Only one shape of triangle can be made from any given set of three sides. Once you have connected three sides to form a triangle, you cannot change the size of the angles. (The triangle is a rigid structure!)

Now you'll explore to see if other polygons have this property. For this activity, you'll need some bendable drinking straws.

3. Form a quadrilateral by connecting four bendable straws that are all the same length. (Pinch the short, bendable end of one straw and slide it inside the long end of another straw to form a square. You may wish to make a slit in the short, bendable end of each straw.)

Change the shape of your quadrilateral to form a square.



a. Change the shape of your square to form two different polygons. Draw them.

b. Are quadrilaterals rigid structures?

Check your answers on page 63 in the Appendix.

A **regular polygon** is one in which all of its sides are the same length and all of its angles are the same size.

The square is the only quadrilateral that has all four sides the same length and all four angles the same measure. For this reason, the square is the only quadrilateral that's a regular polygon.

4. One at a time, connect more straws of the same length to your quadrilateral to make a pentagon, a hexagon, and an octagon. Test each of them to show that they are not rigid shapes. How can you form a regular pentagon, a regular hexagon, and a regular octagon?

5. Look back at the traffic signs on page 21. Which of them are regular polygons?

6. Cut five bendable straws into lengths of 15 cm, 15 cm, 10 cm, 6 cm, and 6 cm. (Don't cut the short, bendable end.)

   Choose four straws at a time to make the following quadrilaterals. Draw and label pictures to show how you made each.

   a. rectangle
   b. parallelogram
   c. kite
   d. trapezoid

Check your answers on pages 63 and 64 in the Appendix.

Sharing Time

Now it's time to show your home instructor what you have been learning.

Turn to page 119 in the Practice and Homework Book and read the rules for the polygon game. Then play the game with your home instructor.

Challenge Activity

Many communities in Canada have public parks or gardens. The above photograph is of the Public Gardens in Halifax, Nova Scotia.

1. One side of a triangular flower garden in a park is 25 m long and a second side is 30 m long. What can you tell about the length of the third side? Draw pictures to explain your reasoning.

2. If you are told that the shape of the garden is an isosceles triangle, what can you tell about its perimeter? Explain.

Check your answers on page 64 in the Appendix.

Conclusion

In this lesson you reviewed and extended your understanding of 2-D shapes. You explored the properties of triangles by building, sorting, and naming them according to the number of sides. You learned how to identify, describe, and name both irregular and regular polygons.

You found many examples of triangles, quadrilaterals, and other polygons in everyday life. What shapes are in the following photograph?

Turn to Assignment Booklet 9A and complete the Lesson 1 Assignment.

Keep Assignment Booklet 9A until you have completed the entire booklet.

Lesson 2

Tangrams

BRYAN AND CHERRY ALEXANDER PHOTOGRAPHY

Inuit storytellers often use string figures to illustrate their stories. The woman in the photograph is forming a red fox with a bushy tail. The storyteller forms the figures by passing the string around and between the fingers. The directions for making the string figure "the red fox" are on the following website:

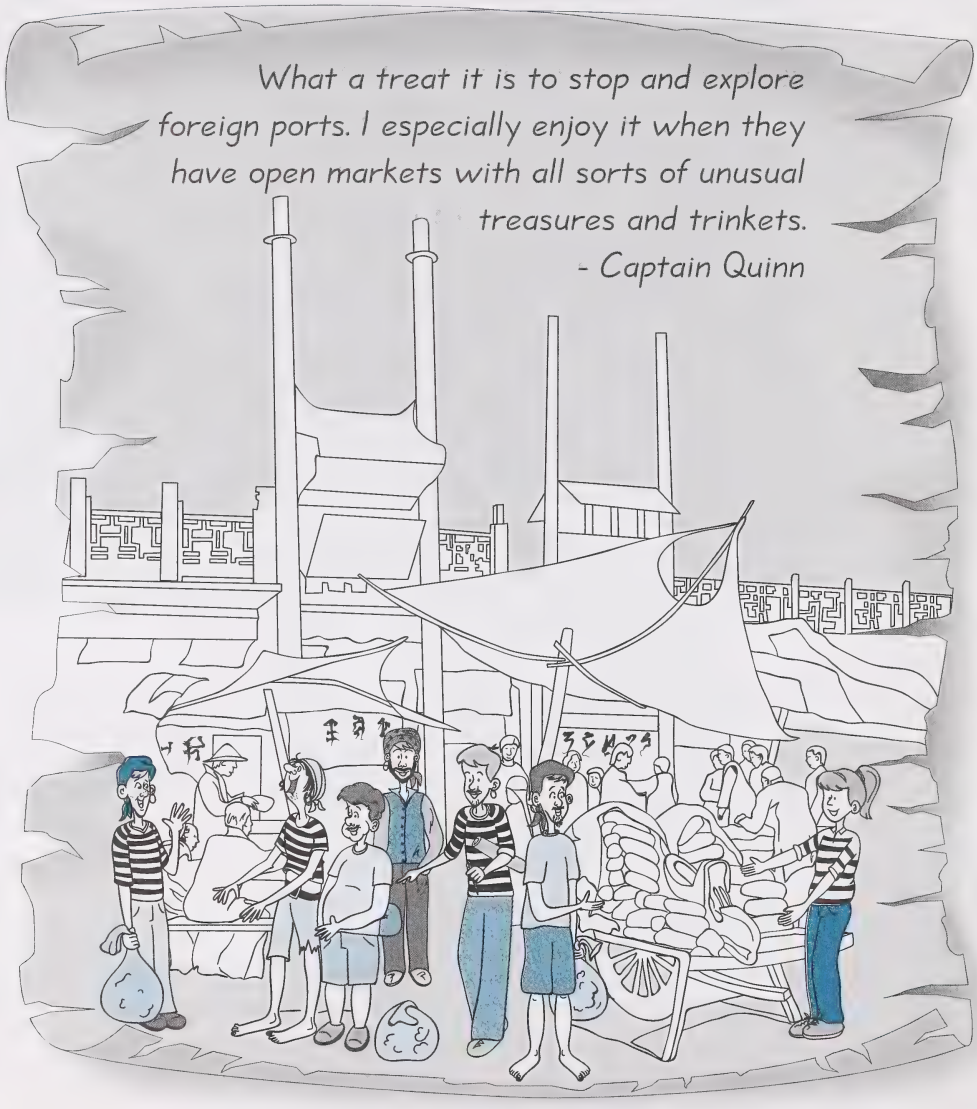
http://www.isfa.org/arctic/jenness.htm

Chinese storytellers often use tangrams to illustrate their stories. The storyteller begins with a square that is cut into seven standard pieces called tans. The storyteller arranges all the tans to show the shape of a character in the tale.

In this lesson you will make a tangram. You will then rearrange the tans to make a specific character. You will use the tangram to review the use of geometric terms.

Activity 1

Today you will complete tangram puzzles.


What a treat it is to stop and explore foreign ports. I especially enjoy it when they have open markets with all sorts of unusual treasures and trinkets.
- Captain Quinn

At one port in the Far East, Captain Quinn traded three of his silver coins for a marvelous porcelain puzzle called a **tangram**.

Captain Quinn was fascinated by the legend the merchant told him about the puzzle's origin:

Long ago, in a remote village of China, there lived a poor man by the name of Tan. The Emperor, who Tan admired greatly, planned to visit the village. The only treasure Tan owned was a very beautiful porcelain tile, and he decided to present it to the Emperor as a gift. To prepare the tile for the Emperor, Tan started to polish it so that it would shine brilliantly. Much to his horror, Tan dropped the tile and it instantly broke into seven pieces. Though he was devastated, Tan decided to try to put the pieces back into their square shape. He tried and tried, but it was more difficult than he had first thought. Then something wonderful happened! Each time Tan arranged the pieces, he created a wonderful picture. Tan decided to show the tile pieces to the Emperor. It turned out that the Emperor enjoyed puzzles and was delighted with Tan's gift!

Find the tangrams in the Appendix. Pull out the page and carefully cut out the seven pieces (called tans). Notice that there are five triangles, a square, and a parallelogram.

1. Mix up the pieces and then put them together again to form the large square.

2. Find the two designs of the cat and sailboat in the Appendix. Arrange the seven tans so that they cover each design. (**Hint:** The parallelogram can be flipped. It's the only piece where the back and front do not match.)

Check your answers on page 65 in the Appendix.

There are many websites on the Internet with information about tangrams. The following website has a movie that shows how the tangram can be used in storytelling:

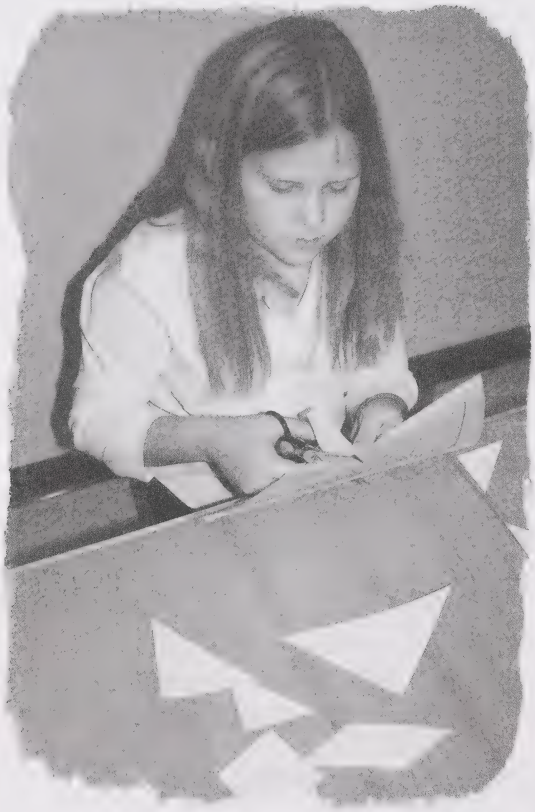
http://www.tygh.co.uk/tan/tan.htm

Sharing Time

Now it's time to show your home instructor what you have been learning.

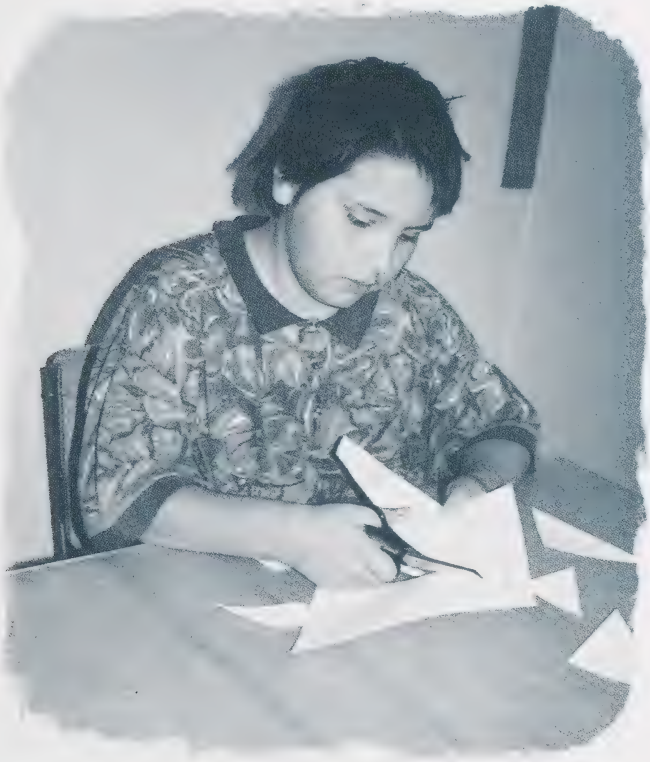
Make a picture of your own with all the tangram pieces. Trace the outline of your picture. Give it to your home instructor and ask him or her to cover your outlined shape with the seven tangram pieces.

You may wish to put aside your outlined shape and try to cover it up yourself later.



Activity 2

Today you will make geometric shapes with a tangram.



Take out your tangram pieces.

1. Form a square with triangles 1 and 2.

2. Use pieces 3, 4, 5, 6, and 7 to form a square the same size as the square you made with triangles 1 and 2. (**Hint:** Try covering the square you made in question 1 with the remaining pieces.)

Check your answers on pages 65 and 66 in the Appendix.

3. Begin with the square you made in question 2. Show how you can add triangles 1 and 2 to the square in different ways to form the following shapes.

   a. a large rectangle
   b. a large parallelogram
   c. a large trapezoid
   d. a large right triangle

Check your answers on page 66 in the Appendix.

4. Use triangles 4 and 6 to cover the following pieces.

   a. triangle 3
   b. square 5
   c. parallelogram 7

5. Use the following tangram pieces to cover triangle 1.

   a. triangles 4, 6, and 3
   b. triangles 4 and 6 and square 5
   c. triangles 4 and 6 and parallelogram 7

6. If the area of square 5 is 1 square unit, find the area of the original tangram square formed by all seven pieces. Explain.

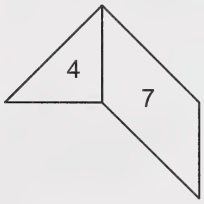
Check your answers on pages 66 and 67 in the Appendix.

Activity 3

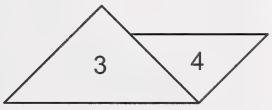
Today you will explore how polygons can be made by joining two or more tangram pieces.

Your task is to use one or more of your tangram pieces to form as many of the following polygons as possible: triangle, square, rectangle, trapezoid, parallelogram, pentagon, and hexagon. The outside edges of the polygons must be complete sides of pieces (no partial sides "sticking out").

For example, you can make a pentagon with two pieces in the following ways, but only one way is correct.



This is OK.



This is **not** OK.

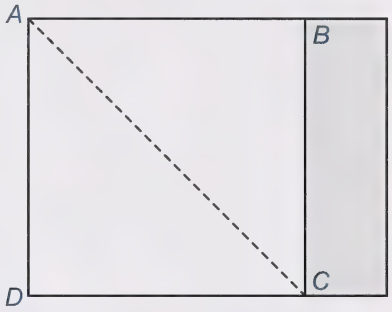
Draw pictures to show how you make each polygon.

Check your answers on pages 67 to 71 in the Appendix.

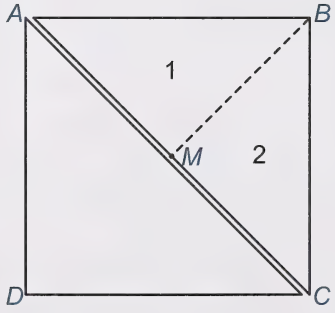
Challenge Activity

Use the following steps to make a tangram.

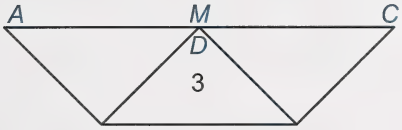
Step 1: Begin with a rectangular sheet of paper and make the largest square possible. Fold the paper so that a short side (*AD*) lies on a long side (*AB*). This will form square *ABCD* with diagonal *AC*. Cut off the extra rectangular strip and put it aside. (You can use it as a bookmark if you want.)



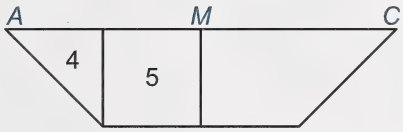
Step 2: Fold and cut along diagonal *AC* to form triangles *ABC* and *ADC*. Fold triangle *ABC* in half to form two right triangles, *AMB* and *BMC*. Cut along the fold. Label these triangles 1 and 2.



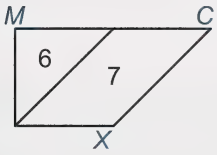
Step 3: Fold vertex *D* to meet point *M*. Cut along the fold line to form a right triangle. Label this triangle 3.



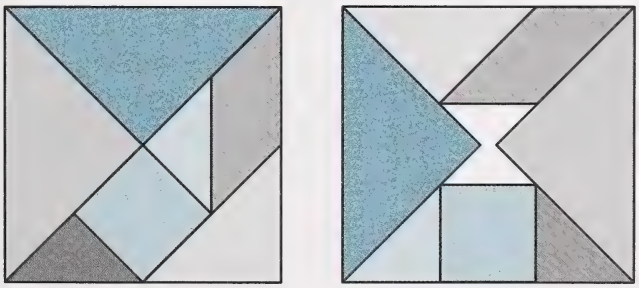
Step 4: Fold *C* to meet *A*. Cut along the fold line. Fold *A* to meet *M*. Cut along the fold line. Label the small right triangle 4 and the square 5.



Step 5: Fold vertex *M* to meet vertex *X*. Cut along the fold line. Label the small right triangle 6 and the parallelogram 7.



Put all seven tangram pieces together as shown below.



Do both of these arrangements of tangram pieces form squares with the same area? Explain.

Check your answer on page 72 in the Appendix.

Conclusion

In this lesson you used a tangram to make pictures and polygons. In China a tangram can be used when storytelling.

In the introduction to this lesson you discovered that string figures are used in some Inuit stories.

How is making pictures with string similar to and different from making pictures with tangram pieces?

Turn to Assignment Booklet 9A and complete the Lesson 2 Assignment.

When you are done, send Assignment Booklet 9A to your distance learning teacher to be marked.

Lesson 3

Building and Drawing 3-D Objects

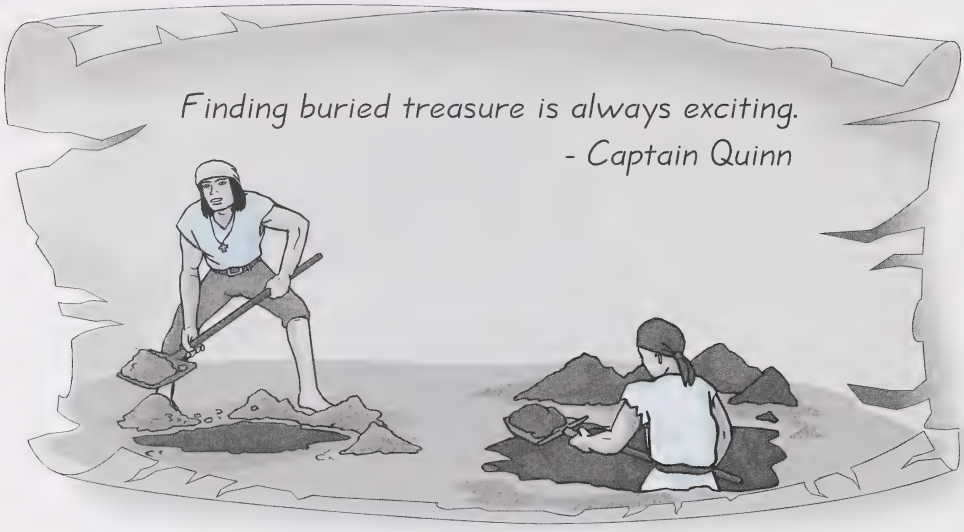
Manufacturers use many different shapes and sizes of 3-D packages for their products. For example, soup is sold in cylindrical cans. Cereal is sold in rectangular solids. Some products have more unusual packaging. For example, Toblerone® chocolate bars are sold in triangular prisms.

Designers use their knowledge of shape and space when creating packaging. What are some of the factors that must be considered when designing a package?

In this lesson you will draw pictures of 3-D objects on triangular dot paper. You will explore planes of symmetry in 3-D objects and extend your understanding of the relationship between 2-D objects and 3-D shapes.

Activity 1

Today you will draw 3-D objects on triangular dot paper.



1. Two sailors were looking for some treasure that had been stolen by pirates and buried on an island. They became excited when they were digging in the sand and their shovels hit something solid. They removed more sand and found that they could see one square face of a treasure chest. One of the sailors said that the chest must be a cube, but the other sailor said that they couldn't be sure unless they dug up more of the chest.

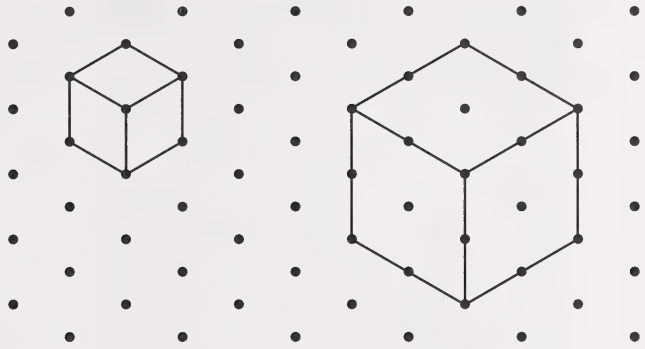
   a. Use the small cubes from a set of base ten blocks to help explain which sailor was correct. This will help you visualize what the chest might look like, knowing only that one face of it is a square.

   b. If the chest was a rectangular solid but not a cube, why might the pirates who buried it have stood it on one end?

2. If a treasure chest was a rectangular solid, how many faces would you have to see in order to be certain of all its dimensions?

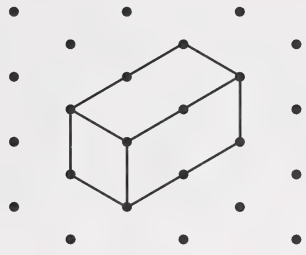
Check your answers on pages 72 and73 in the Appendix.

A talented carpenter made sets of treasure boxes that nested (fit one inside the other) when they were empty. In one such set, all the boxes were cubes. Each edge of the smallest box was 1 dm, and the dimensions of each larger box increased by 1 dm. The first two possible sizes of cubes are shown below.



3. Find a sheet of triangular dot paper in the Appendix. Copy the two cubes shown above onto the sheet. Continue drawing larger and larger cubes until you have filled your sheet.

4. The treasure boxes in another nesting set are rectangular solids. The smallest box in the set is shown.

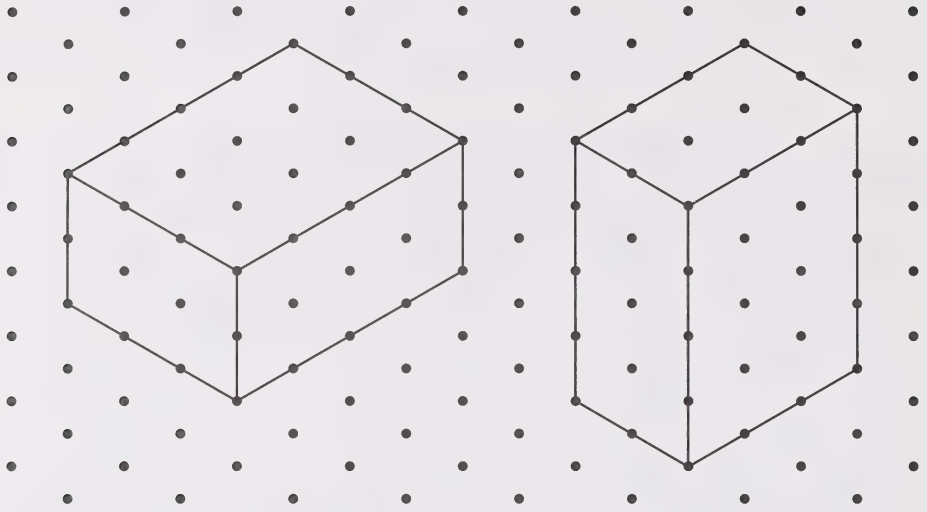


   a. If 1 cm on the triangular dot paper represents 1 dm, what are the actual dimensions of the box?

   b. The length of each edge of the next larger box increases by 1 dm. Draw the next box on triangular dot paper and label its dimensions.

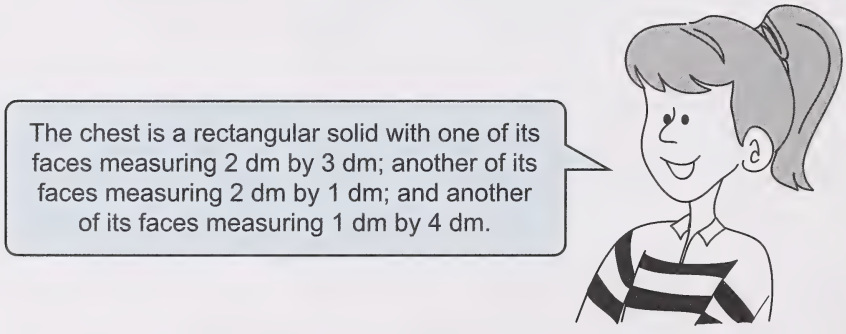
   c. The lengths of the edges of the next two boxes increased in the same way. Draw the next two boxes on triangular dot paper and label their dimensions.

5. Two different views of the same packing crate are shown below.



a. Find the dimensions of each of the three different faces of the crate.
b. Draw a different view of the same crate on triangular dot paper.

6. Penny said she found a treasure chest.


The chest is a rectangular solid with one of its faces measuring 2 dm by 3 dm; another of its faces measuring 2 dm by 1 dm; and another of its faces measuring 1 dm by 4 dm.

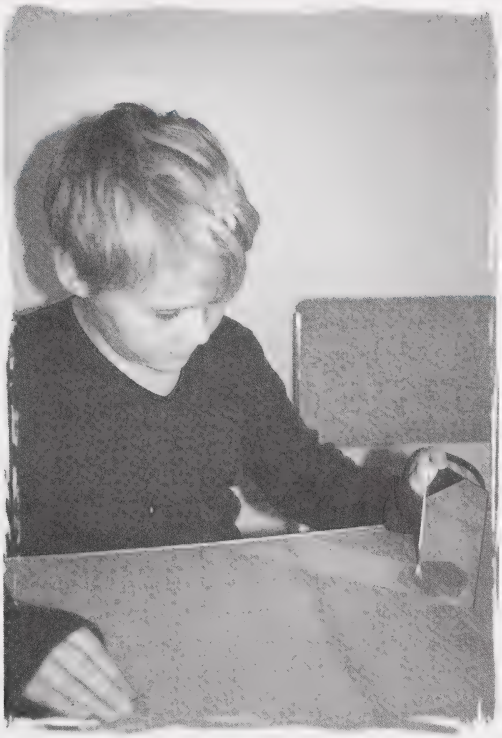
a. Explain how you know that Penny was not telling the truth.

b. If the dimensions of two of the faces were correct, find all possible dimensions of the third face. Draw your answers on triangular dot paper and label the dimensions to show what the chest may have looked like.

Check your answers on pages 73 to 76 in the Appendix.

Activity 2

Today you will find planes of symmetry.



Use a small rectangular mirror to do the following questions.

1. **a.** What 3-D object would you use to describe an orange?

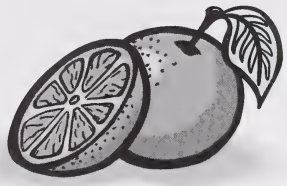
   b. If you want to share an orange with a friend, visualize how you could cut it in half. What do you notice about the size and shape of the two halves?

   c. When you look at the cut face of the orange, what 2-D shape do you see?

   d. If you hold the cut face of the orange flat against a mirror, what will you see?

When the reflected image of half an object held flat against a mirror makes the object appear whole again, the mirror is a **plane of symmetry**.

Another way to visualize a plane of symmetry is to fit the two halves of the orange back together with a sheet of paper between them. The sheet of paper represents a plane of symmetry.



Notice that a sphere has an infinite (unlimited) number of planes of symmetry, all going through the centre point of the sphere.

2. Use the small cubes from a set of base ten blocks to make a rectangular solid with dimensions of 2 cm by 4 cm by 6 cm.

   a. Find all the ways you can pull apart your solid so that when you hold half of it against a mirror, it appears to form the whole solid. Draw pictures on triangular dot paper to show how you can split the solid with a plane of symmetry.

   b. How many planes of symmetry do rectangular solids have?

3. Use the small cubes from a set of base ten blocks to make a rectangular solid with dimensions of 2 cm by 3 cm by 4 cm.

   a. Find all the ways you can pull apart your solid so that when you hold half of it flat against a mirror, it appears to form the whole solid. Draw pictures on triangular dot paper to show how you can split the solid with a plane of symmetry.

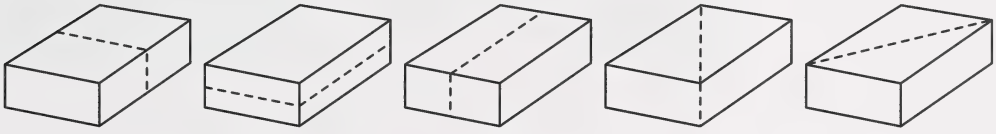
   b. How is your answer to question 3.a. different from your answer to question 2.a.? Explain.

4. Use the small cubes from a set of base ten blocks to make a rectangular solid measuring 1 cm by 2 cm by 3 cm. Imagine the solid is half of a larger solid that was split by a plane of symmetry. Hold the solid flat against a mirror to see what the whole solid might look like.

   a. Draw pictures on triangular dot paper to show all possible whole solids. Label the dimensions of each of them.

   b. How can you tell what the dimensions of the whole solid are if you are given just one piece that was made by splitting the whole solid along a plane of symmetry?

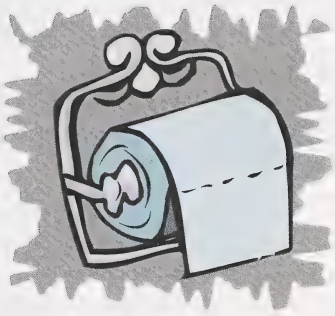
5. Greg used modelling clay to form several identical rectangular prisms. He sliced them in half five ways. Greg said that he found five planes of symmetry.



   Use modelling clay and a mirror to find out if Greg was correct. Explain what you find.

6. **a.** Of what 3-D object is a cardboard toilet-paper roll or paper-towel roll an example?

   b. Visualize how many planes of symmetry a paper roll has. Gather together several cardboard rolls. Cut each roll differently and test for symmetry by placing each half against a mirror. Draw pictures to show all the planes of symmetry that you found.



7. Explain how a floor could represent a plane of symmetry in a building.

Check your answers on pages 76 to 78 in the Appendix.

Activity 3

Today you will relate 3-D objects and 2-D shapes.

Sometimes **nets** are used to construct 3-D objects.

A net is a 2-D pattern of a 3-D figure.

1. Turn to page 246 in your textbook and look at the nets for three different boxes. How is each net related to the box that is constructed from it?

Check your answer on page 78 in the Appendix.

Turn to page 256 in your textbook and look at the four shapes in On Your Own at the top of the page. Shapes like these are called **hexominoes**.

A hexomino is a 2-D shape formed by joining the edges of six equal-sized squares.

2. **a.** Use the sheet of 2-cm grid paper from the Appendix to make as many differently shaped hexominoes as you can. Draw pictures to show all of the hexominoes you made.

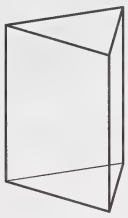
   b. Which of your hexominoes are nets of cubes?

   c. Why aren't all hexominoes nets of cubes?

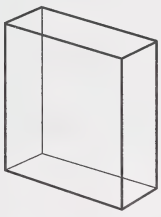
Check your answers on pages 78 and 79 in the Appendix.

The base of a **right prism** can be any kind of polygon, but the side faces (called the lateral faces) are always rectangles. Right prisms are named according to the shape of their bases.

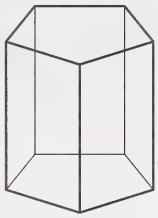
Following are examples of right prisms.



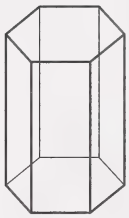
Triangular prism



Rectangular prism



Pentagonal prism



Hexagonal prism

When each face of a rectangular prism is a square, the prism is called a **cube**.

3. Victoria made three different boxes in the shape of triangular prisms. Either use her description of each box to draw its net, or write a question you might ask Victoria to get the information you still need.

   a. "The first box I made is 12 cm high and the bases are equilateral triangles with sides of 6 cm."

   b. "My second box is 10 cm high and the bases are isosceles triangles in which the equal sides are 8 cm."

   c. "My third box is also 10 cm high, but its bases are scalene triangles with sides of 6 cm, 8 cm, and 10 cm."

Going Further

4. A box is in the shape of a regular hexagonal prism. The top and bottom faces are hexagons. All of its other faces are squares with sides of 8 cm.

   a. Make its net out of cardboard and fold it to make the prism. Draw a picture of your prism and label its dimensions.

   b. Explain, in order, all the steps you used to make your net.

5. A candle in the shape of a pentagonal prism is 20 cm tall. What additional information do you need to find the perimeter of its base?

6. The lid to a candy dish has some sides that measure 6 cm, some sides that measure 5 cm, and some sides that measure 4 cm. Could the lid have the shape of an octagon? Explain.

Check your answers on pages 79 to 81 in the Appendix.

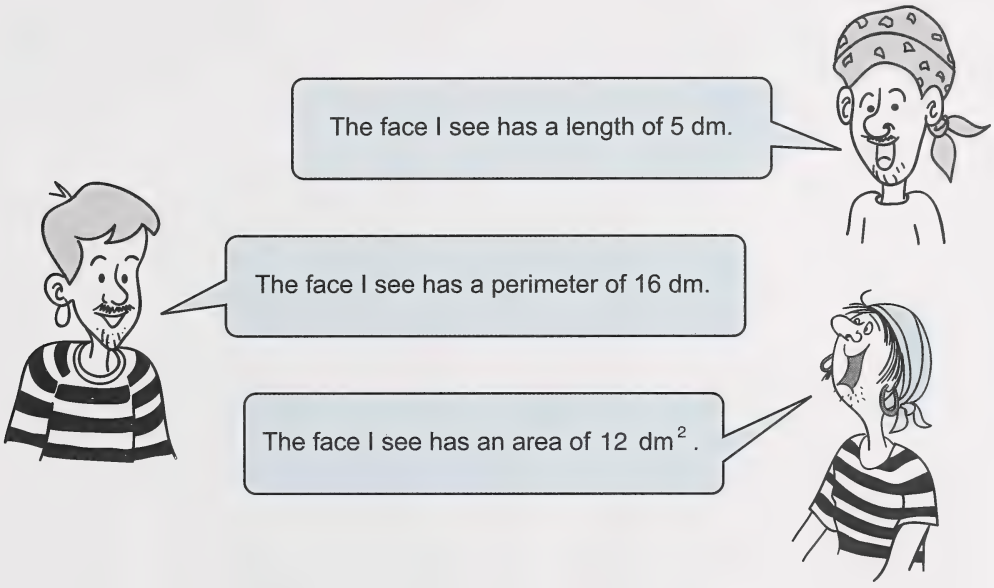
Sharing Time

Now it's time to show your home instructor what you have been learning.

Turn to page 113 in the Practice and Homework Book and complete the exercise. Your home instructor will help you check your answers.

Challenge Activity

Six sailors found a treasure chest that was a rectangular prism. Each sailor looked at a face of the chest that had a different shape and described it.



Find the dimensions of the chest if each edge is measured in whole decimetres. You may find it helpful to use a table like the following.

Dimensions of Face with Area of 12 dm^2	Dimensions of Other Two Faces (dm)	Perimeter of Other Two Faces (dm)

Check your answer on page 81 in the Appendix.

Conclusion

In this lesson you learned how to draw 3-D objects on triangular dot paper. You explored planes of symmetry in 3-D objects, and used the relationship between 3-D objects and 2-D shapes to solve problems.

Manufacturers use many 3-D containers to package their products. Some products have unusual packaging. For example, J-cloths® are sold in hexagonal prisms.

Turn to Assignment Booklet 9B and complete the Lesson 3 Assignment.

Keep Assignment Booklet 9B until you have completed the entire booklet.

Module Summary

In Module 9 you extended your understanding of 3-D objects and 2-D shapes. You reviewed quadrilaterals and learned to describe and classify triangles and other polygons. You were introduced to the tangram puzzle and used it to solve problems by making pictures and polygons. You learned how to draw 3-D shapes using triangular dot paper and you explored planes of symmetry. You reviewed the relationship between 3-D objects and 2-D shapes and applied this relationship to solve problems.

Is the kite in this photograph a polygon?

Turn to Assignment Booklet 9B and complete the Numbers in the News project.

When you are done, send Assignment Booklet 9B to your distance learning teacher to be marked.

Review

This review will help you apply what you learned in Module 9 and prepare for the final test. Discuss with your home instructor when you should begin the Review and how much of the Review you should complete.

1. Turn to page 282 of your textbook. Do questions 1 to 5 of Skill Bank from This Unit.

If you need help with questions 1 to 5 of Skill Bank from This Unit, look back at Lesson 1, where you learned about quadrilaterals and triangles. If you feel you need more practice, do question 2.

2. Turn to page 273 of your textbook. Do questions 1 to 6 of Practise Your Skills.

Check your answers on pages 81 and 82 in the Appendix.

3. Use the tangram pieces you cut out in Lesson 2. Turn to the Appendix and find the tangram puzzles of a man and a woman. Use the seven tangram pieces to cover up each design outline.

4. Use the small cubes from a set of base ten blocks to make a rectangular solid with dimensions of 2 cm by 4 cm by 4 cm.

   a. Draw a picture of the solid on triangular dot paper and label its dimensions.

   b. Find all the ways you can pull apart your solid so that when you hold half of it flat against a mirror, it appears to form the whole solid. Draw pictures of each possible half solid on triangular dot paper.

If you need help with question 4, look back at Lesson 3. Then do question 5.

5. Draw a rectangular solid with the dimensions of 1 cm by 3 cm by 5 cm on triangular dot paper. Label its dimensions and show all possible planes of symmetry.

Check your answers on page 83 in the Appendix.

6. Turn to pages 280 and 281 of your textbook. Do questions 1 to 4 of Problem Bank. Show your work for solving each problem.

Check your answers on pages 84 and 85 in the Appendix.

Conclusion to Adventures on the High Seas

Kassidy turned the last page in Captain Quinn's journal.

Kassidy: Did you have any idea how much math was used at sea? I sure didn't!

Connor: No, me neither. I never realized how important it is for sailors to be good at math.

Kassidy: I'll say! Look how much we learned just from reading through this journal.

Connor: I'll never forget what the captain taught us. Remember how we hoped to find treasure?

Kassidy: We did. It was buried right over there in that pile of musty old books!

Connor: Can you imagine an adventure that could be more out of this world?

Kassidy: Well, let's see where Mathematics 6 takes us …

Congratulations on completing Mathematics 5! We hope you enjoy Mathematics 6!

COURSE SURVEY FOR MATHEMATICS 5
(© 2002)

After you have completed the assignments in this course, please fill in this questionnaire. Your honest thoughts about the course are appreciated. They will help improve the course for future students. Please mail the completed questionnaire to the address given on the last page.

Part A: About Yourself

Your name: _____

Your age: _____

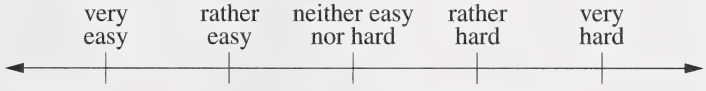
Your distance education school: _____

Your distance education student number: _____

Part B: About the Course

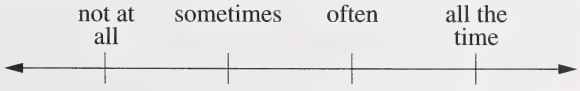
On each line, print an "X" under the words that describe what you think.

1. How difficult did you find this course?

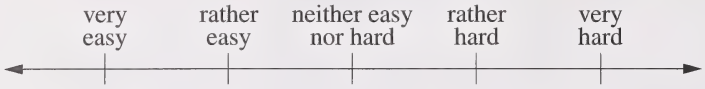


2. How well could you follow the instructions and explanations in the modules?

3. The Internet may have been mentioned in your course as an optional research tool or for optional activities. How often did you use the Internet to complete this course?



4. How easy or hard was the Internet to use as directed by the instructions in this course?



5. If someone helped you with parts of the course, answer the following questions:

   a. Who helped? (parent, friend, etc.) _____

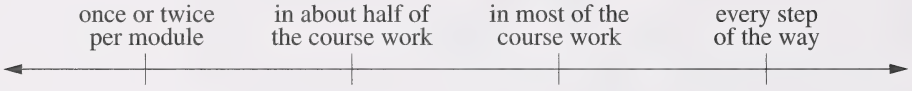
   b. What did this person do to help? _____

   _____

   c. In which parts did this person help you the most? _____

   _____

   d. How much did this person help you?



6. The best thing about this course is _____

   _____

   _____

   _____

7. The part of this course that needs improving most is _____

   _____

   _____

   _____

8. Tell us any other ideas that you have that would improve this course.

_____

_____

_____

_____

_____

9. If you have completed or almost completed another distance education (DE) course within the past year, complete the following chart. If you have done a few distance education courses recently, please choose a course that is similar to this course.

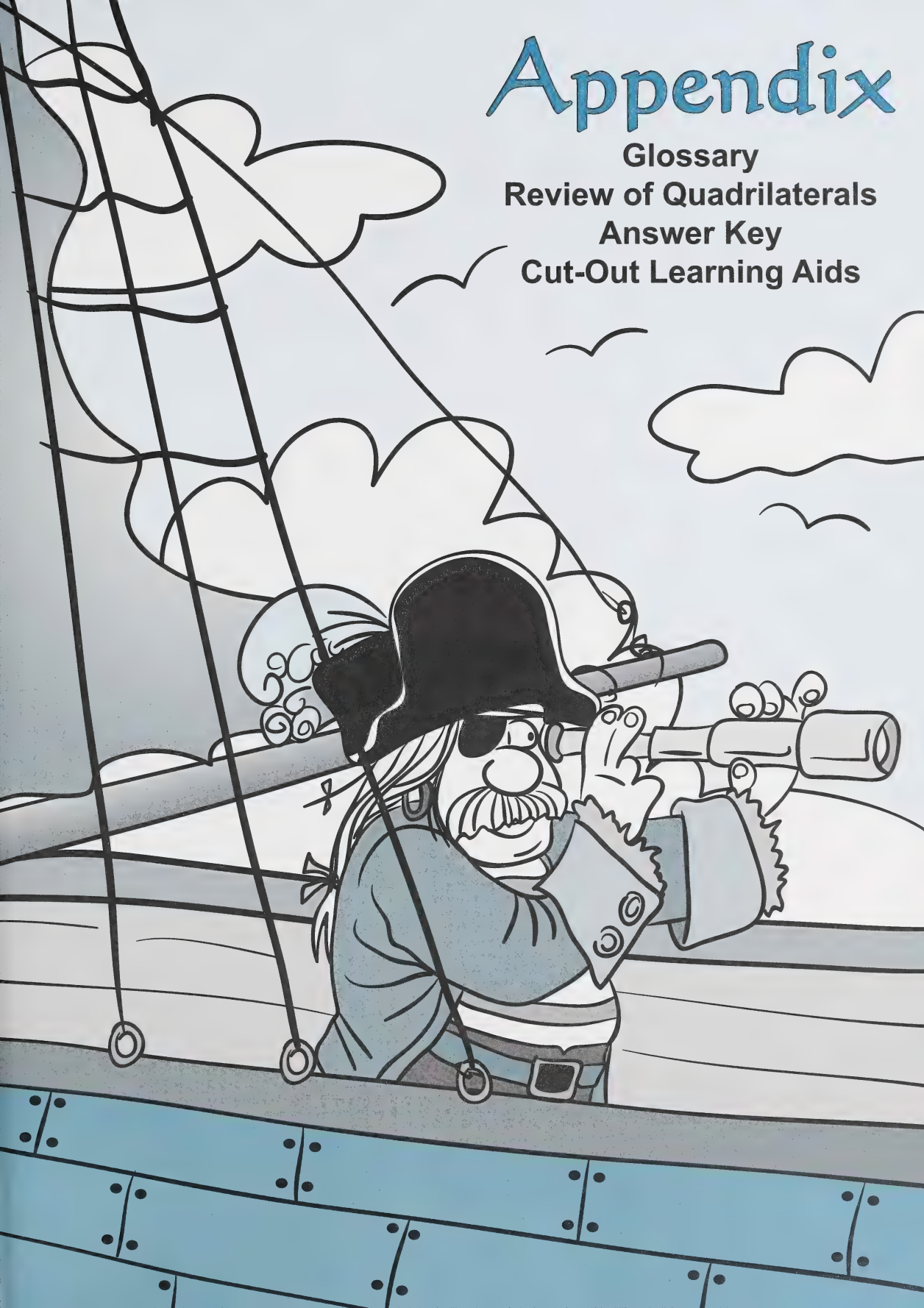
   Print the names of the courses in the following chart. Then put a check mark (✔) in each column to show what you think.

Comparison Between DE Courses	Took More Time	Was More Difficult	Was Better Written	Was More Enjoyable
Name of this course:				
Name of other DE course:				

Thanks for taking the time to complete this questionnaire. Your feedback is important to us. Please return this questionnaire to the address on the right.

Learning Technologies Branch
Box 4000
Barrhead, Alberta
T7N 1P4

If you are enrolled at the Alberta Distance Learning Centre and have been mailing your Assignment Booklets to ADLC, you may return this questionnaire with the final Assignment Booklet in the course.



Appendix

Glossary
Review of Quadrilaterals
Answer Key
Cut-Out Learning Aids

Glossary

cube: a 3-D figure with six equal square faces

dart: a concave trapezium with two pairs of equal adjacent sides

equilateral triangle: a triangle with three equal sides

face: a flat surface of a solid figure

hexagon: a polygon with six sides

hexomino: a 2-D shape formed by joining the edges of six equal-sized squares

isosceles triangle: a triangle with two equal sides

kite: a convex trapezium with two pairs of equal adjacent sides

octagon: a polygon with eight sides

net: a 2-D pattern of a 3-D figure

parallelogram: a quadrilateral with two pairs of parallel sides

pentagon: a polygon with five sides

plane of symmetry: a plane that cuts a 3-D object into two identical parts

polygon: a closed 2-D shape that has only straight sides

quadrilateral: a polygon with four sides

rectangle: a parallelogram with a right angle

regular polygon: a polygon with equal sides and equal angles

rhombus: a parallelogram with four equal sides

right prism: a solid figure in which all the side (lateral) faces are rectangles

scalene triangle: a triangle with no equal sides

solid figure: a three-dimensional figure

square: a parallelogram with four equal sides and a right angle

tangram: a Chinese puzzle consisting of a square cut into seven pieces called tans

trapezium: a quadrilateral with no parallel sides

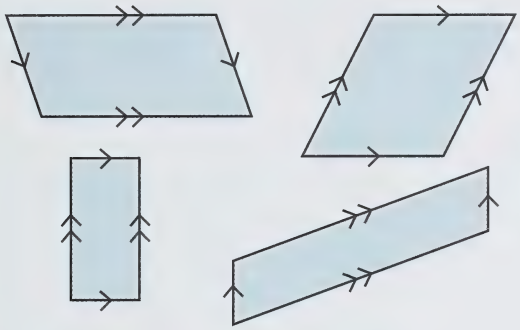
trapezoid: a quadrilateral with one pair of parallel sides

triangle: a polygon with three sides

Review of Quadrilaterals

A quadrilateral with two pairs of parallel sides is called a **parallelogram**.

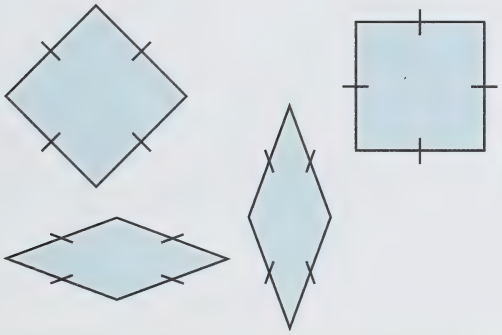
Each of these figures is a parallelogram.



The symbols $\rightarrow$ and $\rightarrow\!\!\rightarrow$ indicate pairs of parallel sides.

A parallelogram with four equal sides is called a **rhombus**.

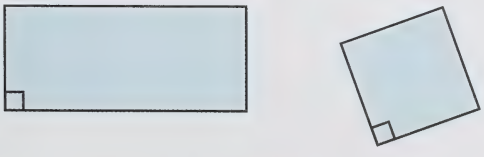
Each of these parallelograms is a rhombus.



The slashes indicate equal sides.

A parallelogram with a right angle is called a **rectangle**.

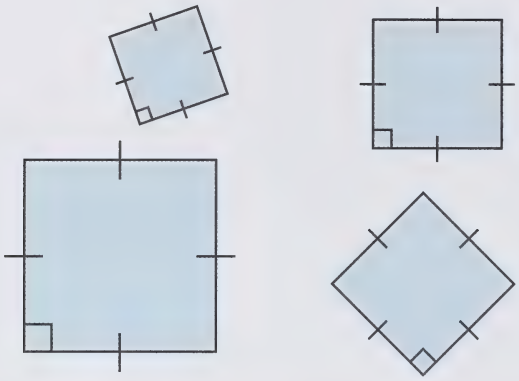
Each of these parallelograms is a rectangle.



The symbol $\llcorner$ indicates a right angle.

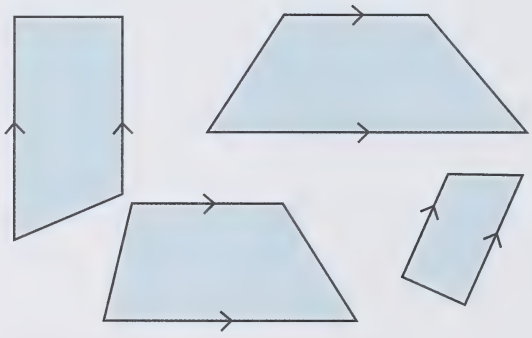
A parallelogram with four equal sides and a right angle is called a **square**.

Each of these parallelograms is a square.



A quadrilateral with one pair of parallel sides is called a **trapezoid**.

Each of these figures is a trapezoid.

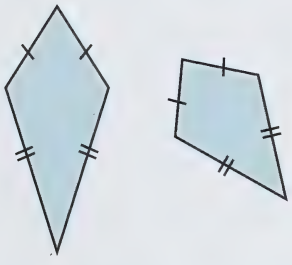


A quadrilateral with no parallel sides is called a **trapezium**. A trapezium is often called simply a quadrilateral.

Each of these figures is a trapezium.

A **kite** is a convex trapezium with two sets of equal adjacent sides. (A convex figure is a figure in which all the sides turn outward. Adjacent sides are sides that are next to each other.)

Each of these figures is a kite.



A **dart** is a concave trapezium with two sets of equal adjacent sides. (A concave figure is a figure in which some of the sides turn inward.)

Each of these figures is a dart.

Answer Key

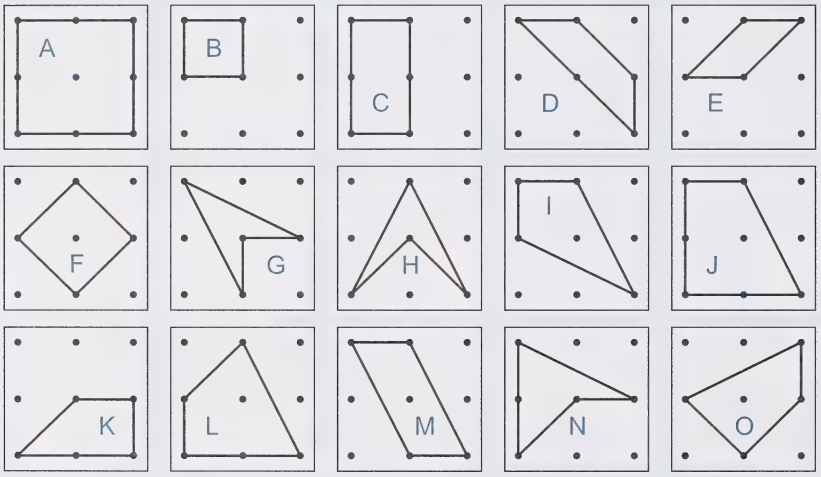
Lesson 1: Identifying and Drawing 2-D Shapes

Activity 1

1. Most of the sails were quadrilaterals because that shape has a greater area and can catch more wind than a triangular sail.

2. **a.** This kind of sail is shaped like a trapezoid.
   b. Each wing-like extension is shaped like a triangle.

3. **a.** rectangle **b.** trapezoid **c.** parallelogram
   d. rhombus **e.** square **f.** trapezoid

4. 

5. Quadrilaterals A, B, and F are squares.
   Quadrilateral C is a rectangle.
   Quadrilaterals D, J, and K are trapezoids.
   Quadrilaterals E and M are parallelograms.
   Quadrilaterals G and H are darts.
   Quadrilateral I is a kite.
   Quadrilaterals L, N, and O are trapeziums (or simply quadrilaterals).

Activity 2

1. Answers will vary. A sample answer is given.

   First, make all possible triangles that have three sides the same length. Next, make all possible triangles that have two sides the same length. Last, make all possible triangles that have no sides the same length.

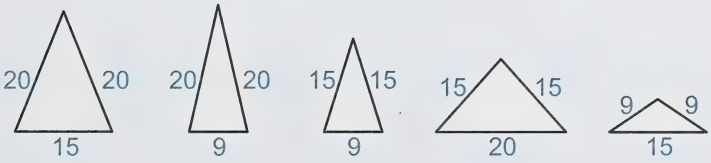
2. **a.** You are able to make three equilateral triangles of different size or shape with your straws.

   b.

   c. All the equilateral triangles have the same shape.

3. **a.** You are able to make five isosceles triangles of different size or shape with your straws.

   b.



   c. All the isosceles triangles have different shapes.

   d. It is not possible because the 9-cm straws will not meet.

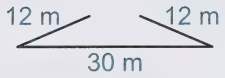
4. **a.** You are able to make only one scalene triangle with your straws.

   b. A triangle has three sides and there are only three different lengths of straws to use, so only one scalene triangle is possible.

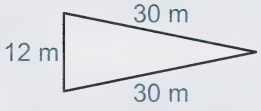
5. No. Once you form a triangle using any three straws, the size and shape of that triangle cannot be changed.

6. No, it is not always possible to make a triangle using any three straws. If the length of two of the sides put together is shorter than the length of the third side, then they will not meet to form a triangle.

7. **a.** If the perimeter of the garden was 54 m, the two equal sides of the isosceles triangle would both be 12 m long. Lengths of 12 m, 12 m, and 30 m cannot be used to form a triangle because $12\ \text{m} + 12\ \text{m} = 24\ \text{m}$, which is shorter than the third side that measures 30 m.



b. You would need 72 m of fencing to enclose the garden.



Perimeter $= 30\ \text{m} + 30\ \text{m} + 12\ \text{m} = 72\ \text{m}$

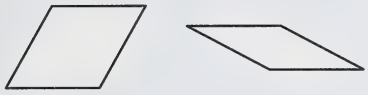
Activity 3

1.

Sign	Number of Straight Sides	Are All Sides the Same Length?	Number of Vertices	Number of Angles	Are All Angles the Same Size?	Name of Shape (based on number of sides)
Stop	8	yes	8	8	yes	octagon
One-Way	4	no	4	4	yes	quadrilateral
Highway	5	no	5	5	no	pentagon
Yield	3	yes	3	3	yes	triangle
Keep Right	4	no	4	4	yes	quadrilateral
School Zone	5	no	5	5	no	pentagon
No Exit	4	yes	4	4	yes	quadrilateral
Speed Limit	4	no	4	4	yes	quadrilateral

2. Any polygon has the same number of vertices and angles as it has sides.

3. **a.**



b. Quadrilaterals are not rigid shapes. Even though you used a set of four straws that are all the same length, it is possible to make quadrilaterals of different shapes. This is because their angles can be changed. (They are not fixed.)

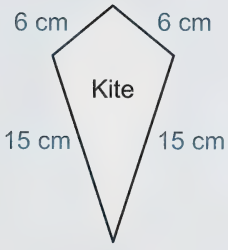
4. You can make a regular polygon using any number of sides that are all the same length by making all of its angles the same measure.

5. The traffic signs that are regular polygons are the stop sign, the no exit sign, and the yield sign.

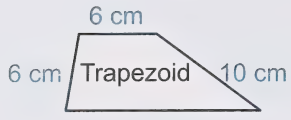
6. **a.**

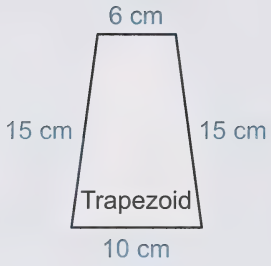
b.

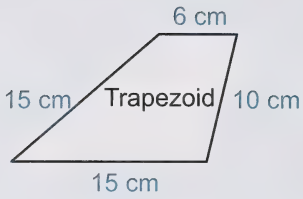
c.



d.



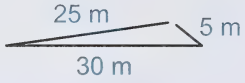




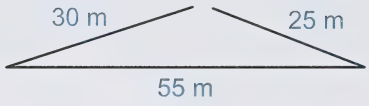
Challenge Activity

1. You know that the combined length of two sides must be longer than the length of the third side, or a triangle cannot be formed. This means that the length of the third side must be greater than 5 m and less than 55 m.

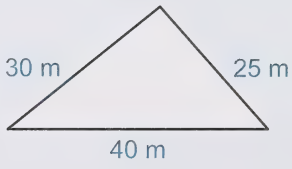
   If the third side is 5 m long, the 25-m side and the 5-m side will join to form a straight line because $25\ \text{m} + 5\ \text{m} = 30\ \text{m}$.

   If the third side is 55 m long, the 25-m side and the 30-m side will join to form a straight line because $25\ \text{m} + 30\ \text{m} = 55\ \text{m}$.

   One possible garden could have dimensions of 25 m by 30 m by 40 m.

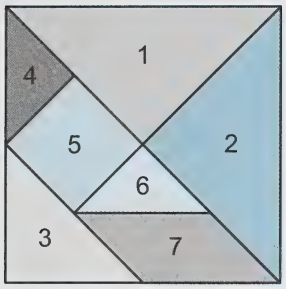
   

2. If the shape of the garden is an isosceles triangle, then two of the sides are the same length, so its perimeter must be $25\ \text{m} + 25\ \text{m} + 30\ \text{m} = 80\ \text{m}$ or $30\ \text{m} + 30\ \text{m} + 25\ \text{m} = 85\ \text{m}$.

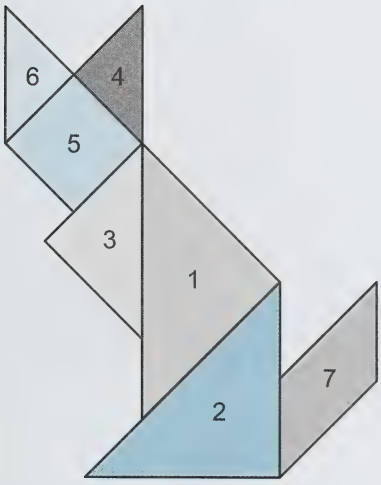
Lesson 2: Tangrams

Activity 1

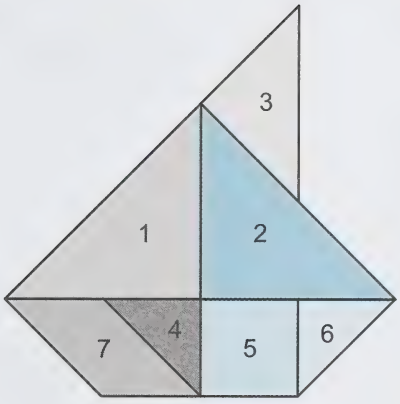
1.



2.



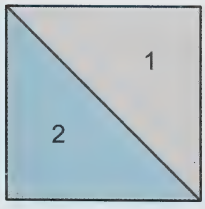
Cat



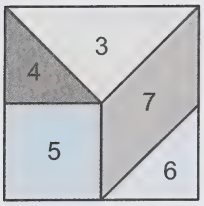
Sailboat

Activity 2

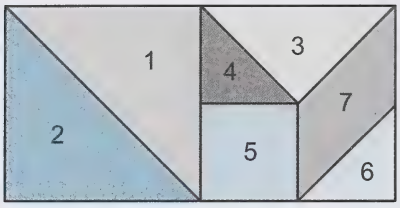
1.



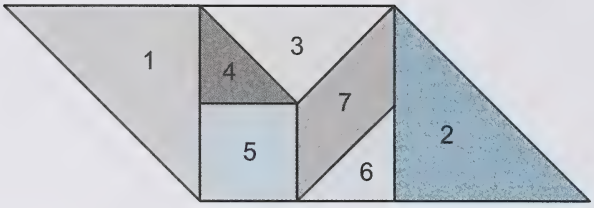
2.



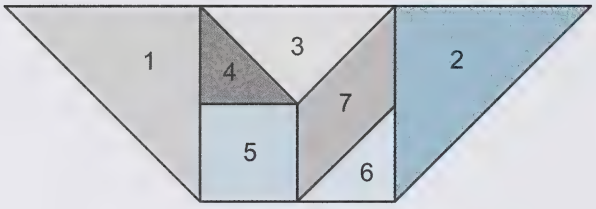
3. a.



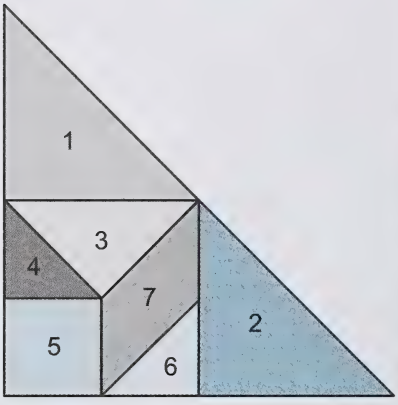
b.



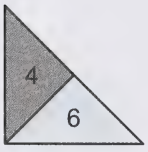
c.



d.

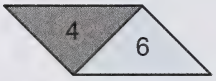


4. a.

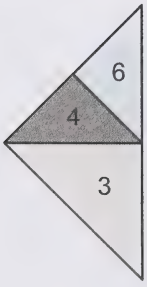


b.

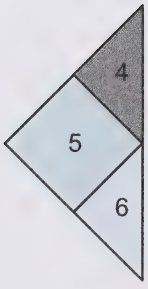
c.



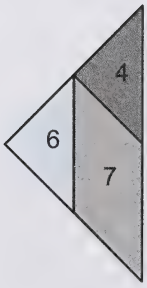
5. a.



b.



c.

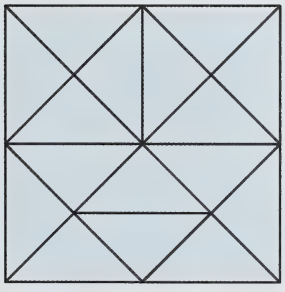


6. If the area of square 5 is 1 square unit of area, the area of the original tangram square formed by all seven pieces is 8 square units.

- area of square 5 = 1 square unit
- area of triangle 4 + area of triangle 6 = area of square 5 = 1 square unit
- area of triangle 3 = area of triangle 4 + area of triangle 6 = 1 square unit
- area of parallelogram 7 = area of triangle 4 + area of triangle 6 = 1 square unit

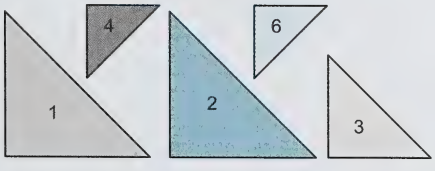
The combined area of pieces 3, 4, 5, 6, and 7 = 4 square units. Since these pieces cover half the area of the original tangram square, its area must be $2 \times 4 = 8$ square units.

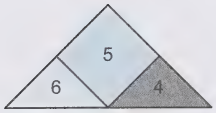
The following picture shows that you need to use 16 triangles like triangle 4 or triangle 6 to cover the whole tangram square. Each of these triangles has an area equal to half of a square unit. Therefore, the area of the whole tangram is $16 \div 2 = 8$ square units.



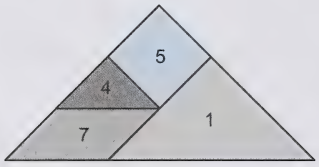
Activity 3

Triangle

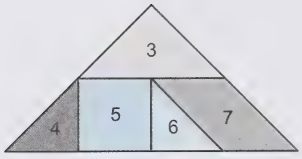




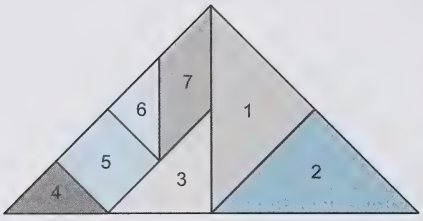
3 Pieces



4 Pieces



5 Pieces



7 Pieces

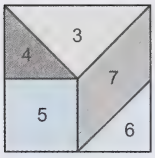
Square

1 Piece

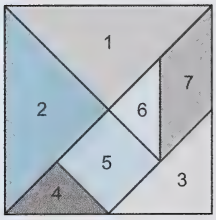
2 Pieces

3 Pieces

4 Pieces



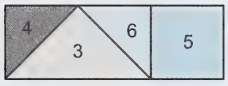
5 Pieces



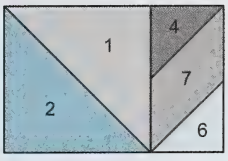
7 Pieces

Rectangle

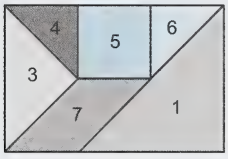
3 Pieces



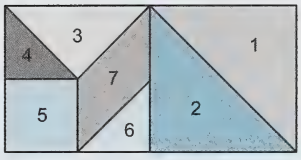
4 Pieces



5 Pieces

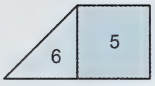


6 Pieces



7 Pieces

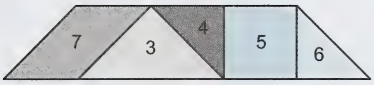
Trapezoid



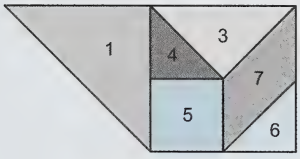
2 Pieces

3 Pieces

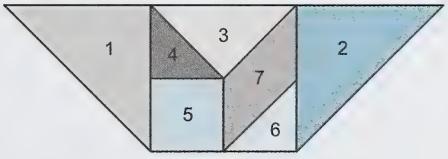
4 Pieces



5 Pieces



6 Pieces



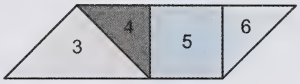
7 Pieces

Parallelogram

1 Piece

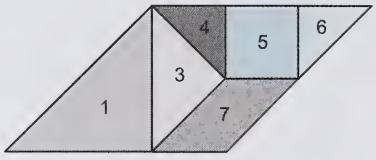
2 Pieces

3 Pieces

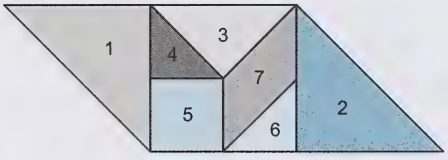


4 Pieces

5 Pieces



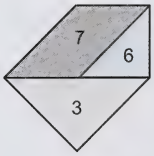
6 Pieces



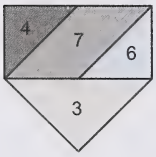
7 Pieces

Pentagon

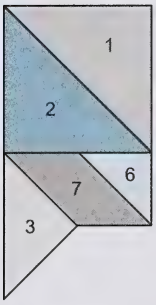
2 Pieces



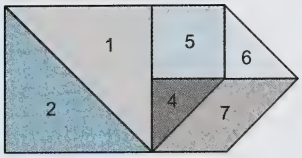
3 Pieces



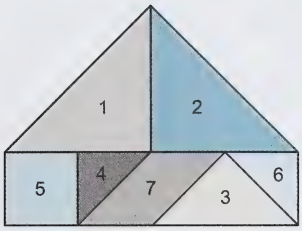
4 Pieces



5 Pieces

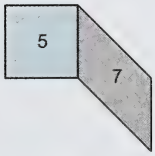


6 Pieces

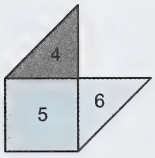


7 Pieces

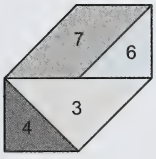
Hexagon



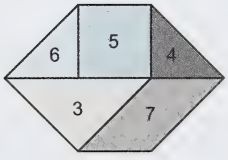
2 Pieces



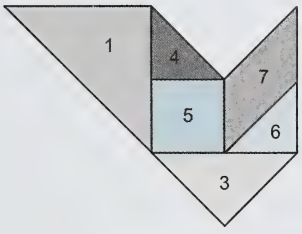
3 Pieces



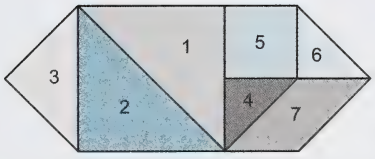
4 Pieces



5 Pieces



6 Pieces



7 Pieces

Challenge Activity

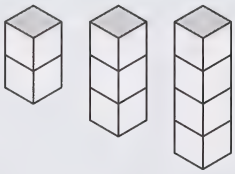
The shape on the right is a rectangle, but it is not a square. One side of the rectangle has the same length as the sides of the square on the left. The other side of the rectangle is a little longer, so the area of the rectangle is greater than the area of the square. That is why the seven tangram pieces do not cover the shape on the right completely.

Lesson 3: Building and Drawing 3-D Objects

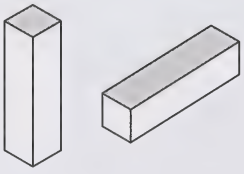
Activity 1

1. a. If one face of the chest is a square, the other faces may or may not be squares. One centicube shows what the chest would look like if it were a cube. The shaded square face on the top is the face the sailors saw.

Add more centicubes, one at a time. This shows that the chest could have a square face on top, and yet not be a cube.

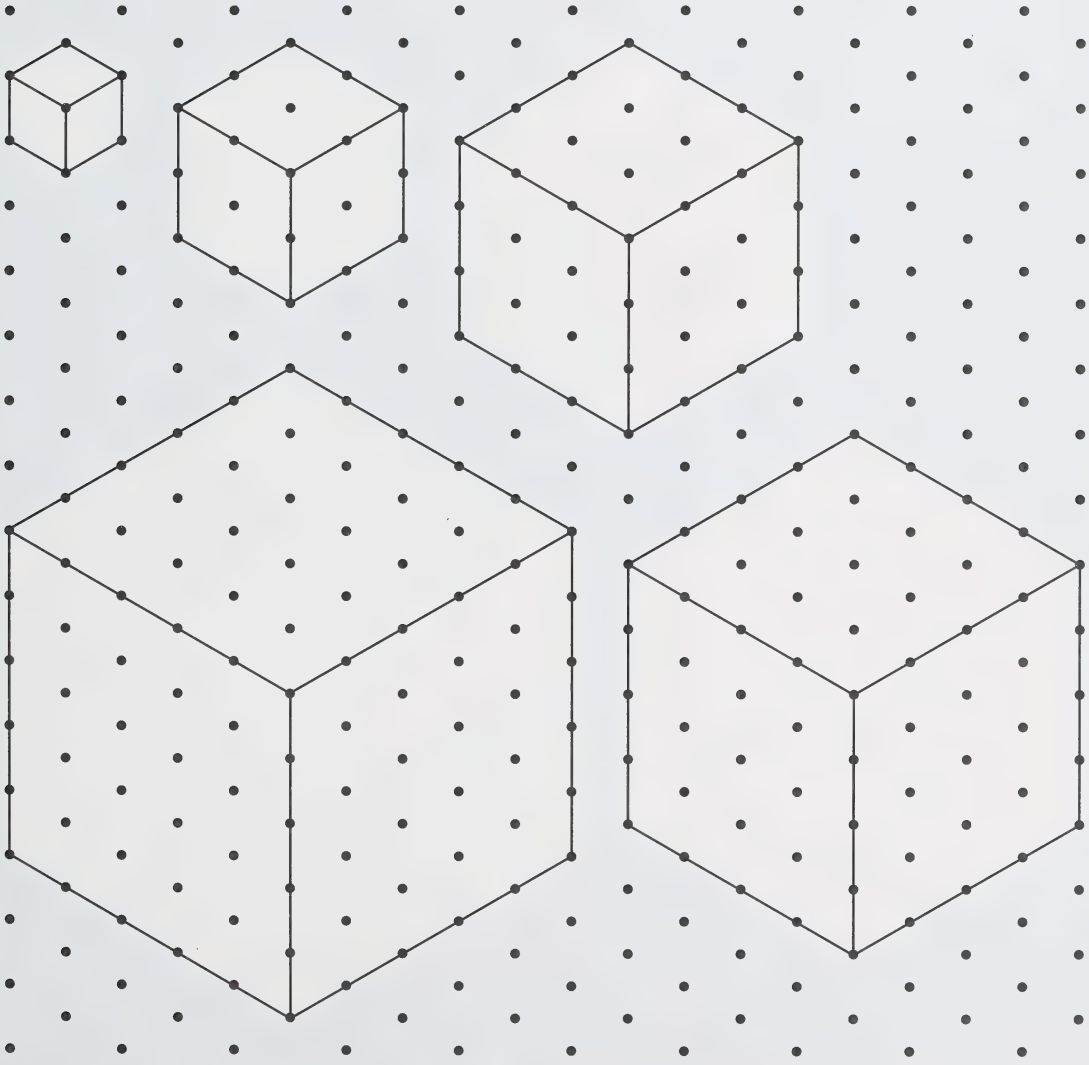


b. If the chest is put on its end, it would be harder to find. This is because the top face has less surface area to hit when someone is searching by poking or digging holes straight down into the sand.



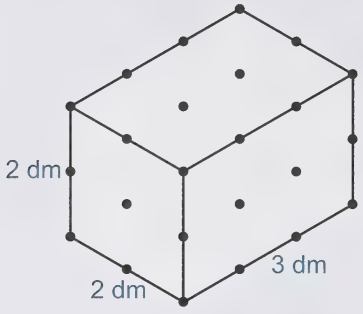
2. If a treasure chest was a rectangular solid, you would you have to see at least two faces that share an edge in order to be certain of all its dimensions. Rectangular solids have three dimensions: length, width, and height. There are three pairs of matching rectangular faces. One pair has dimensions that are length by width, another pair has dimensions that are width by height, and a third pair has dimensions that are height by length. Any one face shows two dimensions. Two faces are needed to show all three dimensions.

3. The first five possible sizes of cubes are shown.

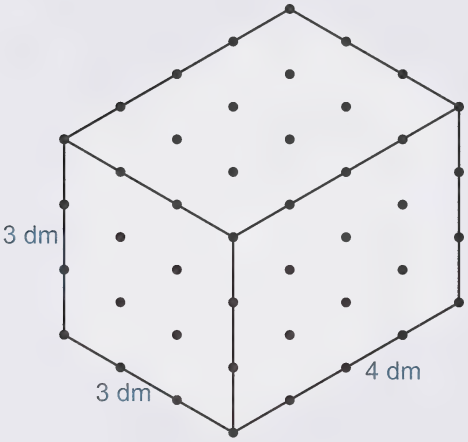


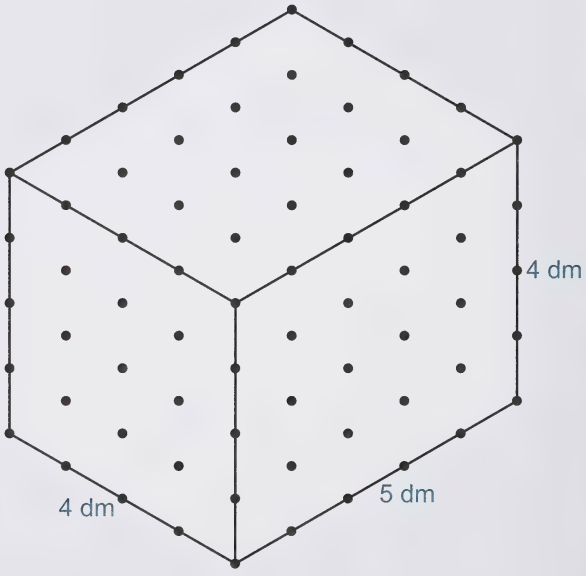
4. a. Its dimensions are 1 dm by 2 dm by 1 dm.

b. The dimensions of the next larger box are 2 dm by 3 dm by 2 dm.



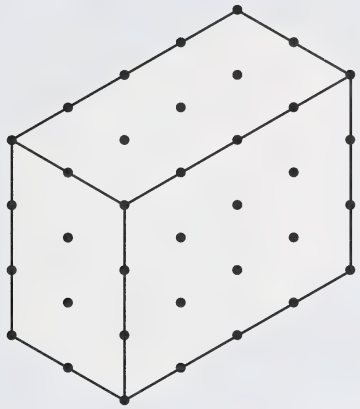
c. The dimensions of the next two larger boxes are 3 dm by 3 dm by 4 dm and 4 dm by 4 dm by 5 dm.





5. a. The dimensions of each of the three different faces of the crate are 2 dm by 3 dm, 2 dm by 4 dm, and 3 dm by 4 dm.

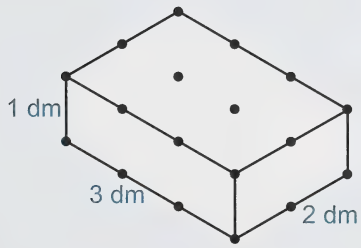
b. A different view of the same crate is shown.



6. a. A rectangular solid has three dimensions, and Penny gave a total of four different measurements for the three faces she described.

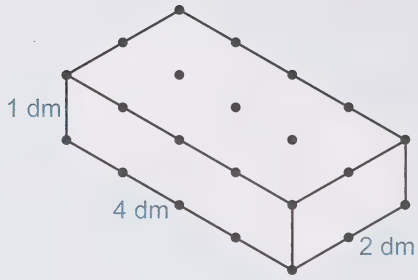
b. Any two faces of a rectangular solid that share an edge must have at least one dimension that is the same.

- If the two correctly measured faces were 2 dm by 3 dm and 2 dm by 1 dm, then the dimensions of third face must be 1 dm by 3 dm.



(Notice that the two faces Penny measured share an edge of 2 m.)

- If the two correctly measured faces were 2 dm by 1 dm and 1 dm by 4 dm, then the dimensions of third face must be 2 dm by 4 dm.



(Notice that the two faces Penny measured share an edge of 1 dm.)

- The two measured faces of 2 dm by 3 dm and 1 dm by 4 dm cannot both be correct because they do not share a dimension. (Notice that these two faces use a total of four different measurements, which is impossible when talking about any rectangular prism.)

Activity 2

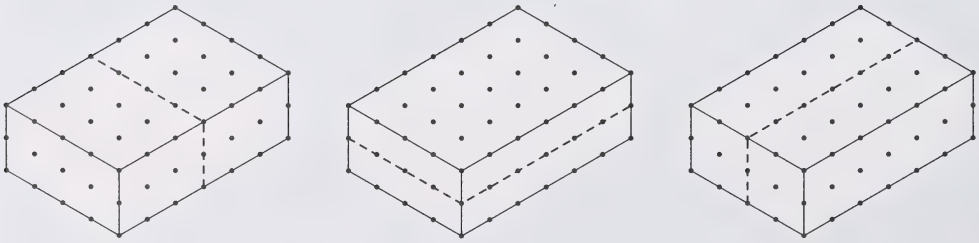
1. a. An orange is like a sphere.

b. The two halves look like identical hemispheres (half-spheres).

c. When you look at the cut face of the orange, you will see a circle.

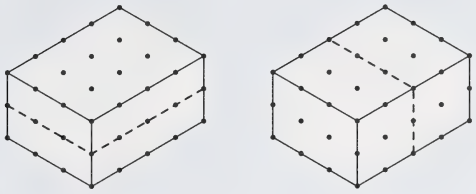
d. If you hold the cut face of the orange flat against a mirror, you will see what appears to be the whole orange.

2. a. You can pull apart your solid in half three ways.

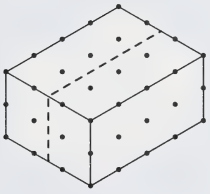


b. All rectangular solids, other than cubes, have exactly three planes of symmetry.

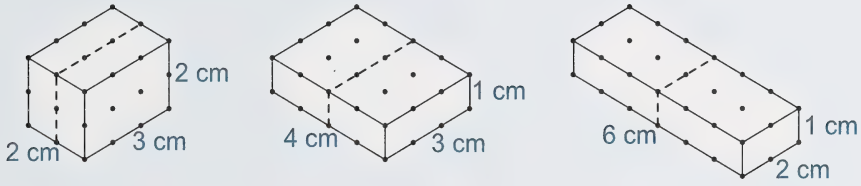
3. a. You can pull apart your solid, making halves, in two ways.



b. This centicube solid could only be pulled apart two ways. One of the dimensions was an odd number. To show the third plane of symmetry, imagine the solid being cut down the middle of the centicubes.



4. a. The three possible solids are shown.

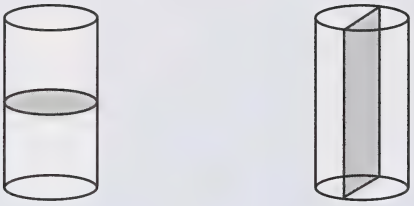


b. To get the possible dimensions of the whole solid, double any one of the three dimensions of the half-solid.

5. Greg is not correct. He did cut the rectangular solid into two congruent halves in five different ways, but the two diagonal cuts are not planes of symmetry. When one of the halves that is cut diagonally is held flat against a mirror, you do not see the whole solid. Remember that all rectangular solids, other than cubes, have exactly three planes of symmetry.

6. **a.** A cardboard toilet-paper roll or paper-towel roll is like a cylinder.

   b. A cylinder has one plane of symmetry that cuts it in half crosswise (parallel to the circular ends) and an infinite number of planes of symmetry that cut it in half lengthwise.

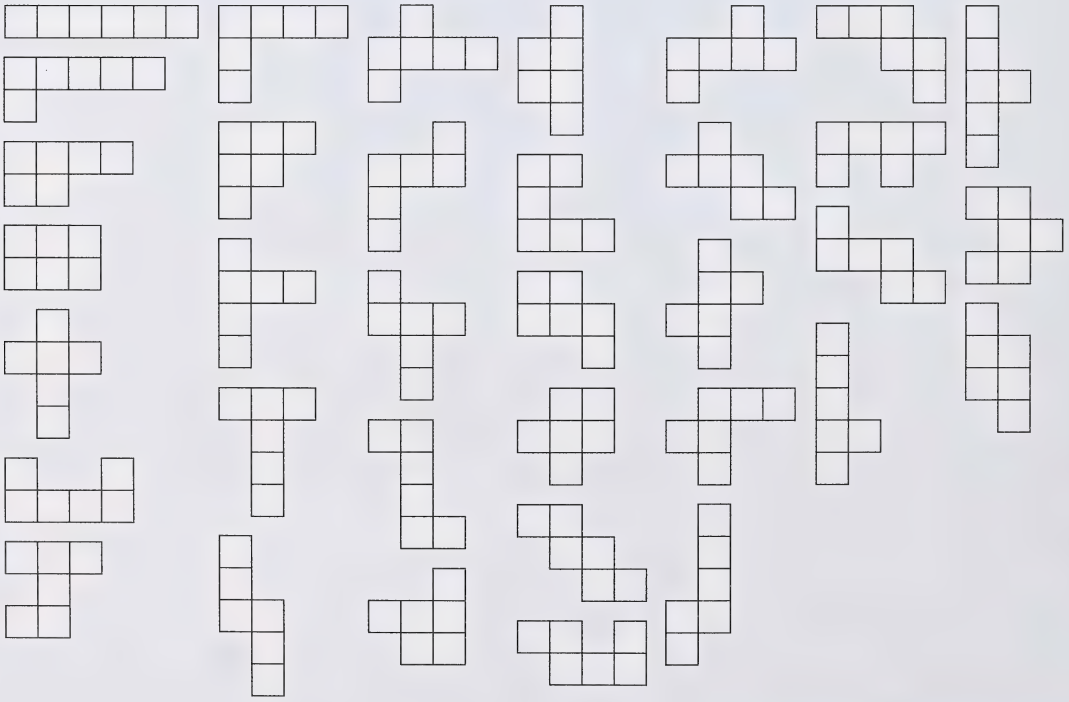


7. A floor can represent a plane of symmetry of a rectangular building only if that floor is half-way up the height of the building.

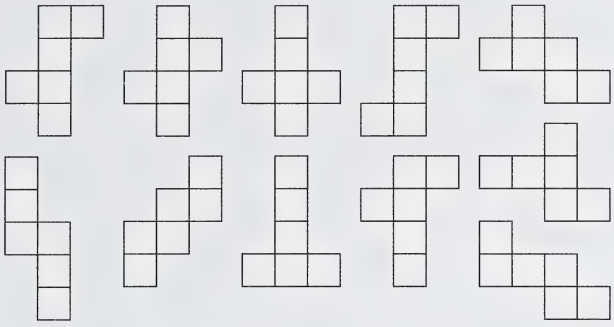
Activity 3

1. Each net is made up of all the faces that are on the box it is used to make. The faces are arranged so the net can be folded up to make the box itself.

2. **a.** There are 35 possible hexominoes. Don't worry if you didn't find all of them.

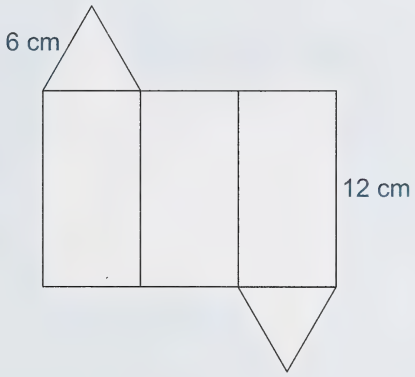


b. The 11 hexominoes that are nets of cubes are shown.



c. Some hexominoes are not nets of cubes. When you fold these to try to make a cube, some of their square faces are out of position and will overlap with others.

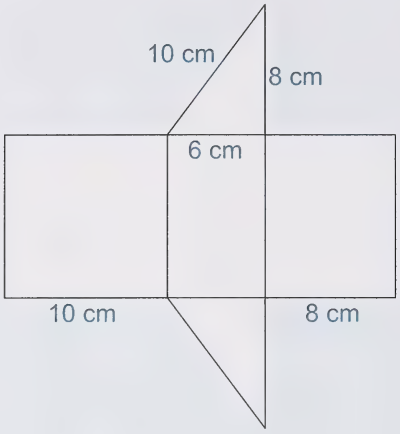
3. a. The net of Victoria's first box is shown.



b. You might ask Victoria either one of these two questions:

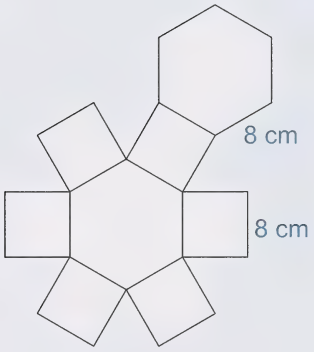
- What is the length of the third side of the triangle?
- What is the measure of the angle formed by the two equal sides of the triangle?

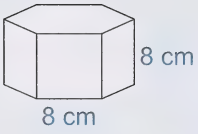
c. The net of Victoria's third box is shown.



4. a.

Net	Prism





b. Use the cardboard from an empty cereal box as follows:

- Measure, draw, and cut out a square with sides of 8 cm.
- Use the square to trace 5 more squares, and cut them out.
- Put the six squares down on a cardboard sheet. Arrange them so that one side of each square becomes one edge of a hexagon. Tape the touching corners of the squares so all six squares stay in place.
- Use this to trace two separate hexagons. Cut out both hexagons.
- Tape one edge of each of the six squares to one of the hexagons.

- Fold up the squares and tape together the edges that touch.
- Complete the prism by taping the second hexagon on top.

5. If the pentagon is regular, then you need to know the width of the rectangular faces or the length of a side of the pentagon. If the pentagon is not regular, then you need to know the length of all its sides.

6. Yes, as long as the lid has a total of eight sides, it is in the shape of an octagon. However, it is not a regular octagon. The sides of an irregular octagon can have different lengths.

Challenge Activity

The face that has an area of 12 dm^2 could have dimensions of 1 dm by 12 dm, 2 dm by 6 dm, or 3 dm by 4 dm.

Dimensions of Face with Area of 12 dm^2	Dimensions of Other Two Faces (dm)	Perimeter of Other Two Faces (dm)
1 dm by 12 dm	• 1 dm by 5 dm • 5 dm by 12 dm	• 12 dm • 34 dm
2 dm by 6 dm	• 2 dm by 5 dm • 5 dm by 6 dm	• 14 dm • 22 dm
3 dm by 4 dm	• 3 dm by 5 dm • 4 dm by 5 dm	• 16 dm • 18 dm

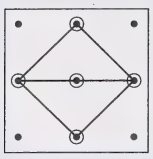
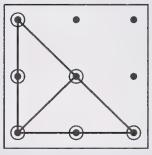
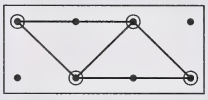
The only face that has a perimeter of 16 dm is 3 dm by 5 dm, so the dimensions must be 3 dm by 4 dm by 5 dm.

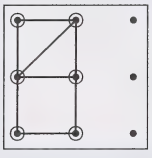
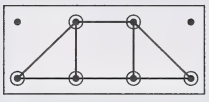
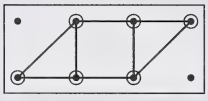
Review

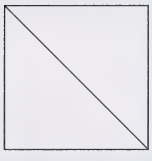
1. **Textbook, page 282, Skill Bank from This Unit, questions 1 to 5**

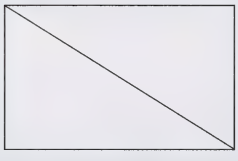
   1. The first triangle does not belong because it is the only equilateral triangle.

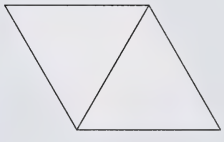
2. **a.** A square is a quadrilateral with four equal sides and four right angles.
   b. A trapezoid is a quadrilateral with only one pair of parallel sides.
   c. A scalene triangle has no equal sides.

3. **a.**  **b.**  **c.** 

4. **a.**  **b.**  **c.** 

5.  two matching right isosceles triangles

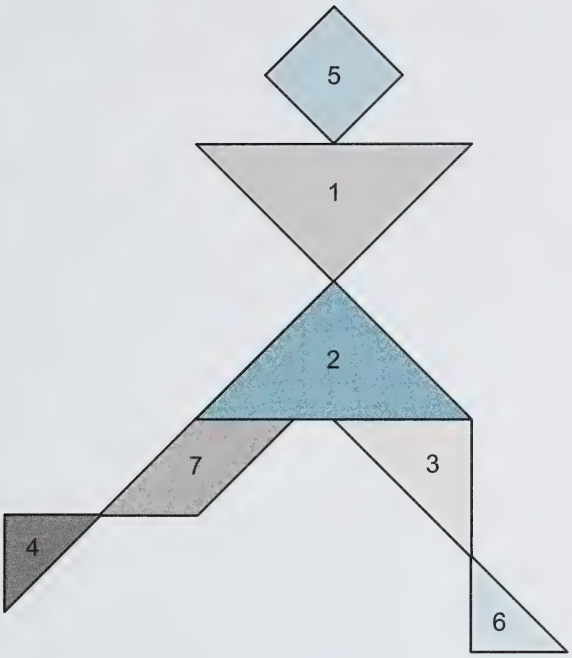
    two matching right scalene triangles

    two matching equilateral triangles

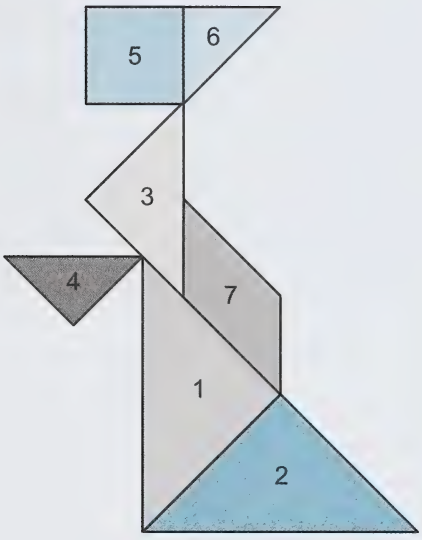
2. Textbook, page 273, Practise Your Skills, questions 1 to 6

1. square
2. rectangle
3. right triangle
4. rhombus
5. hexagon
6. pentagon

3.

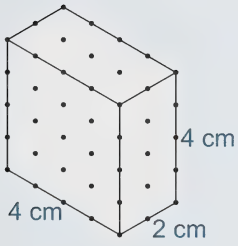


Man

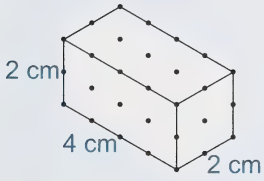


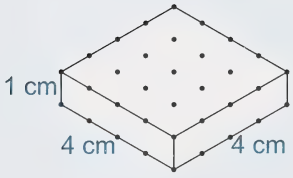
Woman

4. a.

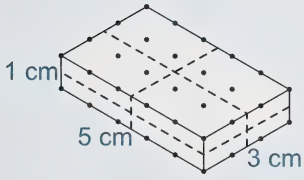


b.





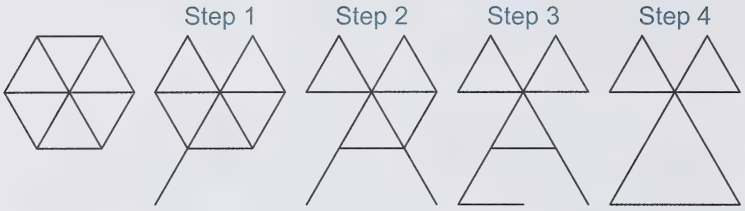
5.



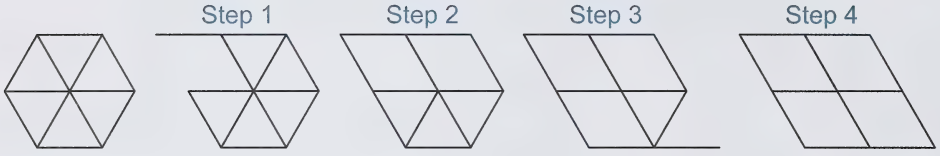
6. Textbook, pages 280 and 281, Problem Bank, questions 1 to 4

1. Answers will vary. Sample answers are given.

a.

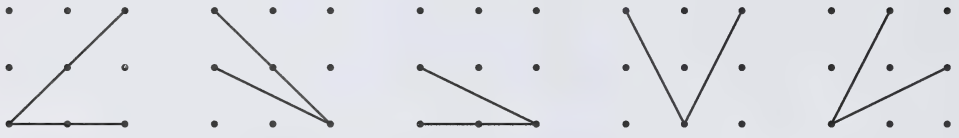


b.

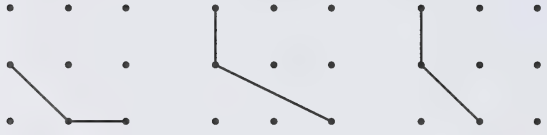


2. Answers will vary. Sample answers are given.

a.

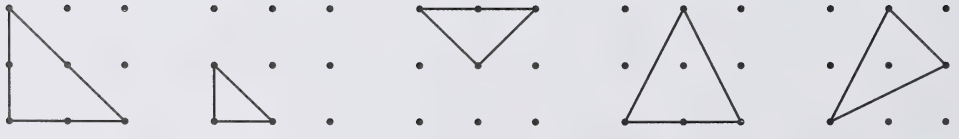


b.



c.

d.



e.

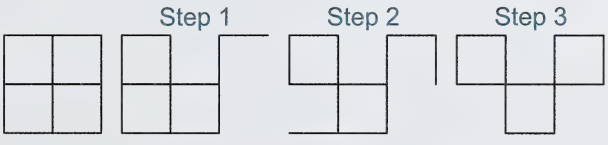
3. a. There are five possible tetrominoes.

b. The square tetromino has the smallest perimeter of 8 cm.

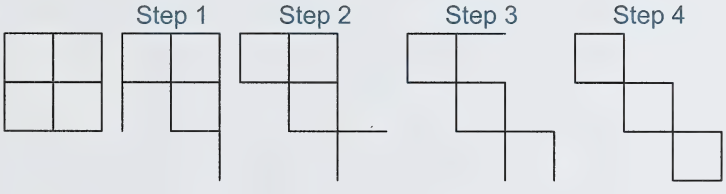
c. All tetrominoes except the square have a perimeter of 10 cm.

4. Answers will vary. Sample answers are given.

a.



b.



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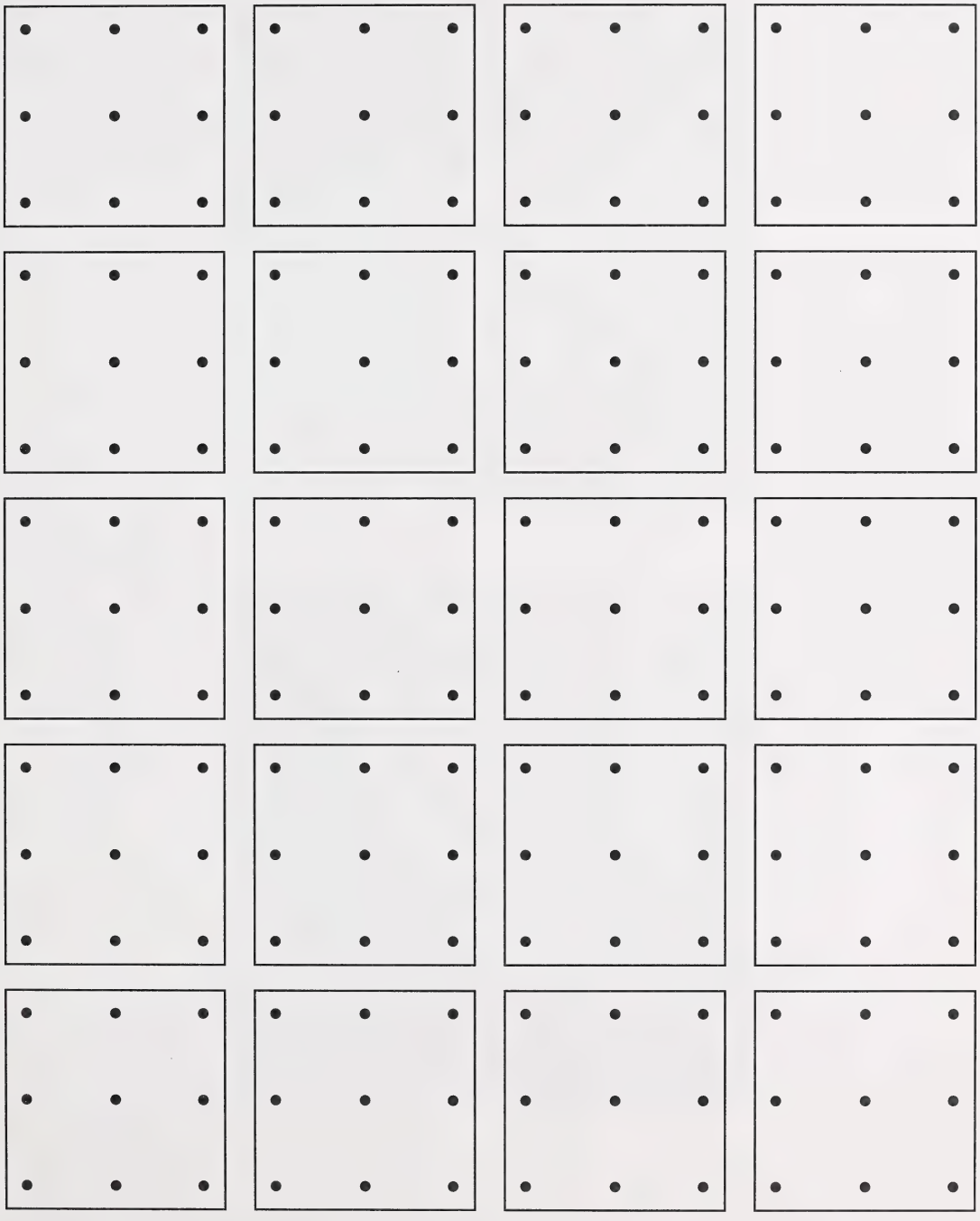
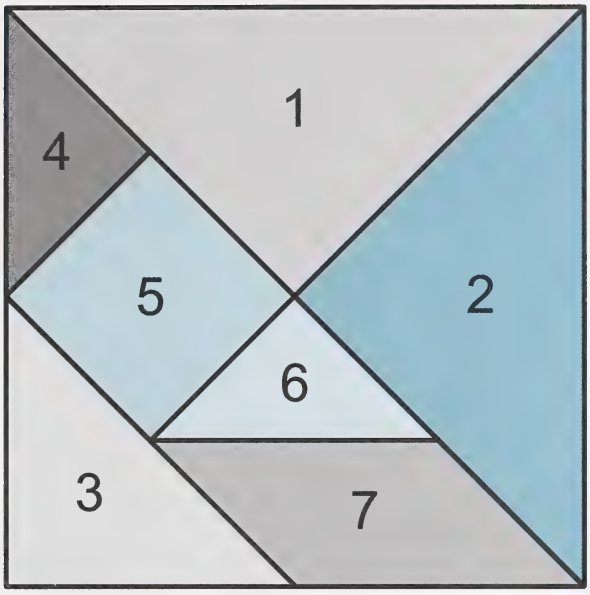
Cut-Out Learning Aids

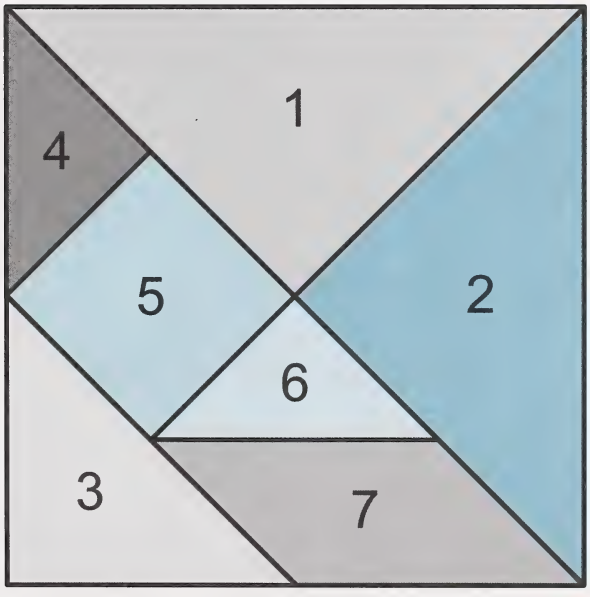
Quadrilaterals

By joining any of the nine dots in a 3×3 array of dots, draw 15 different quadrilaterals.



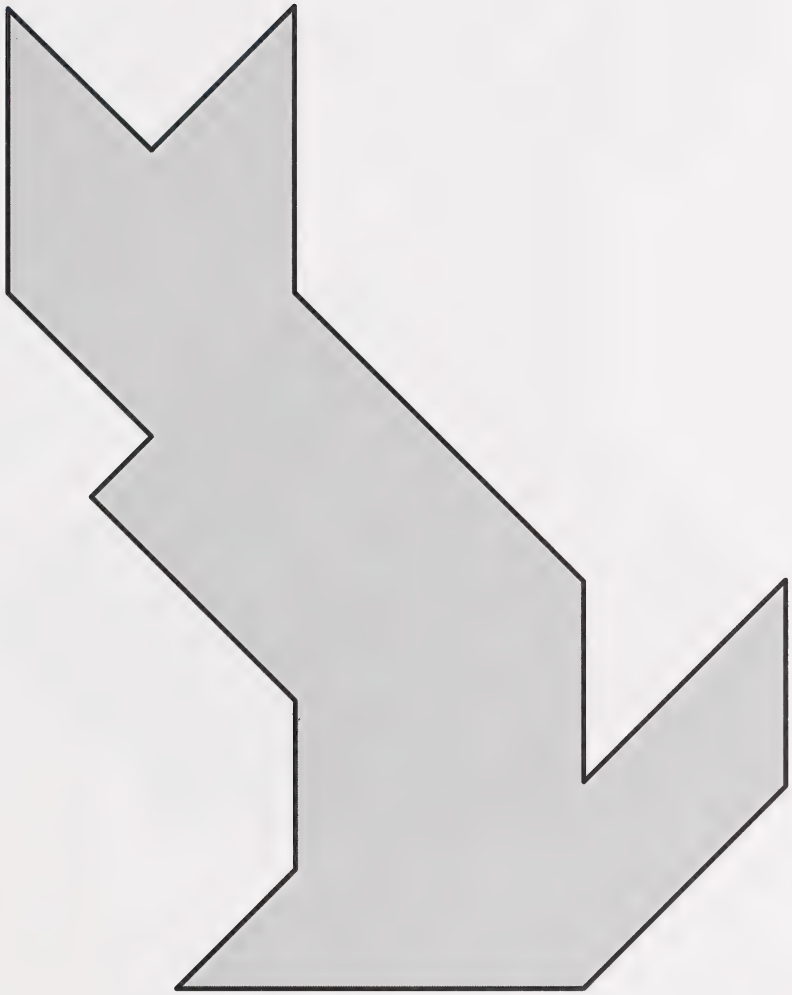
Tangrams





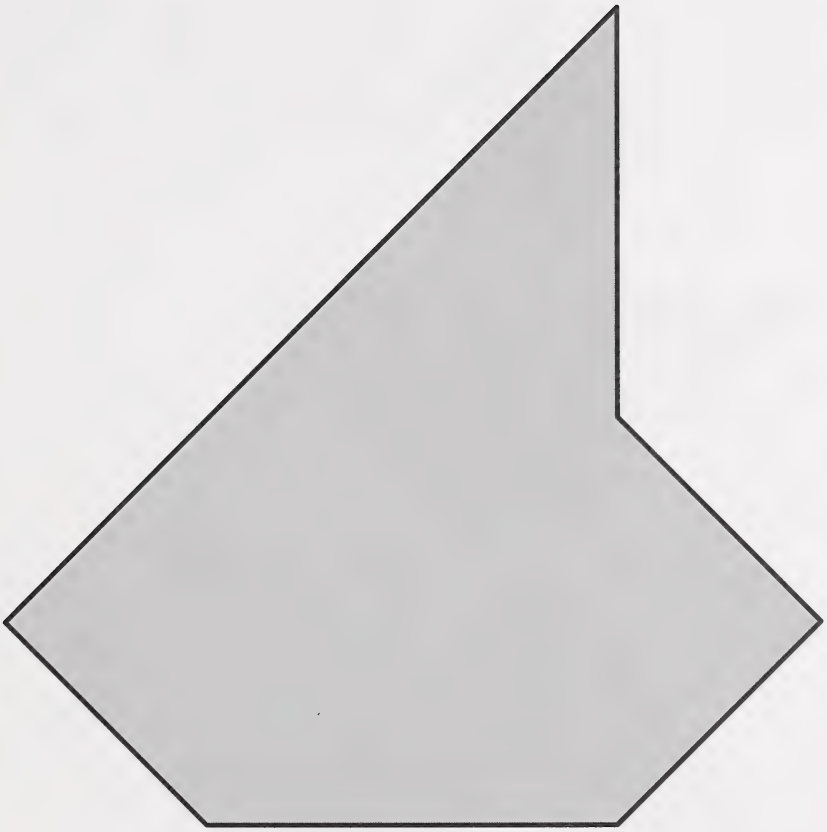
Tangram Puzzle

Cat



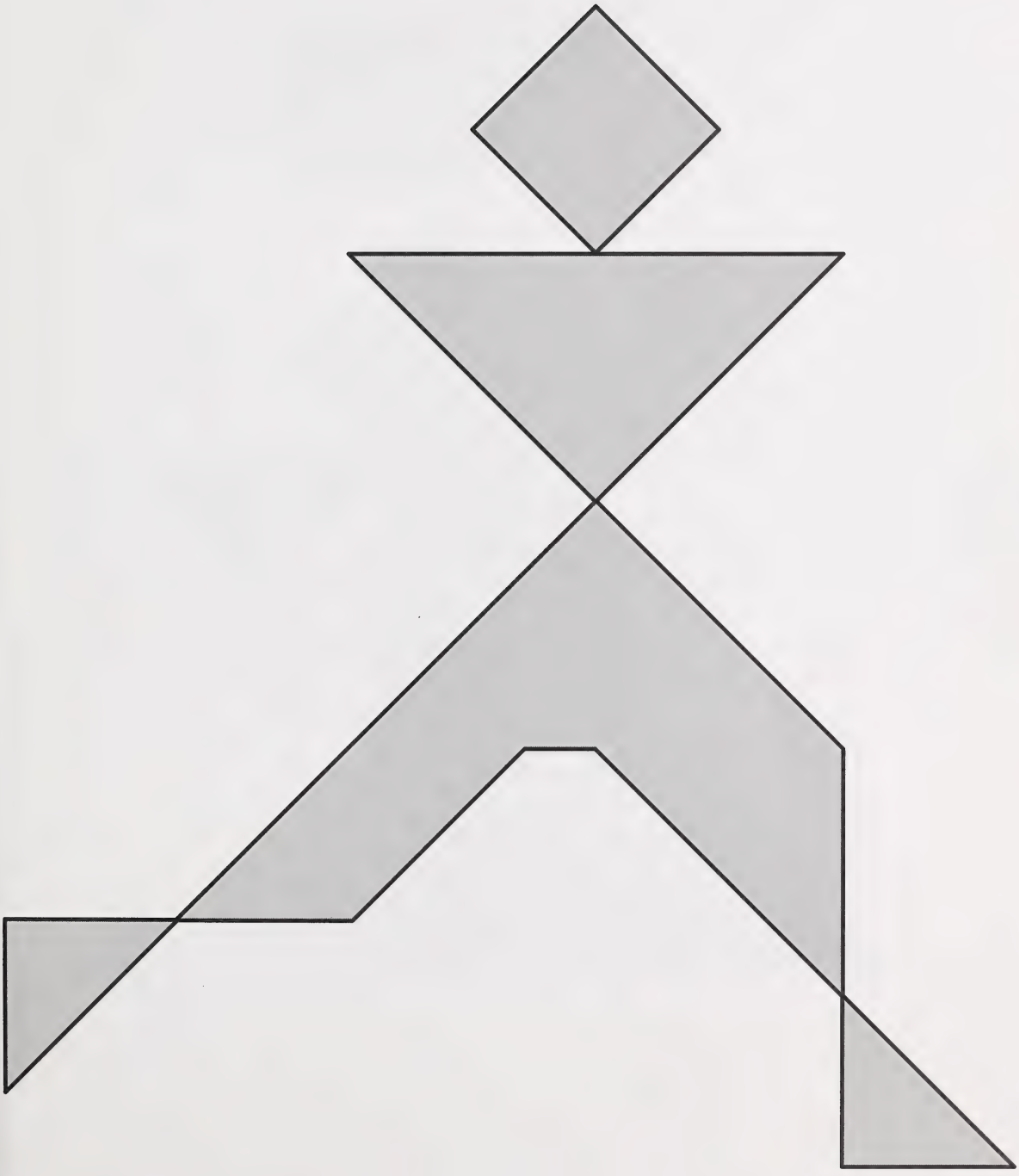
Tangram Puzzle

Sailboat



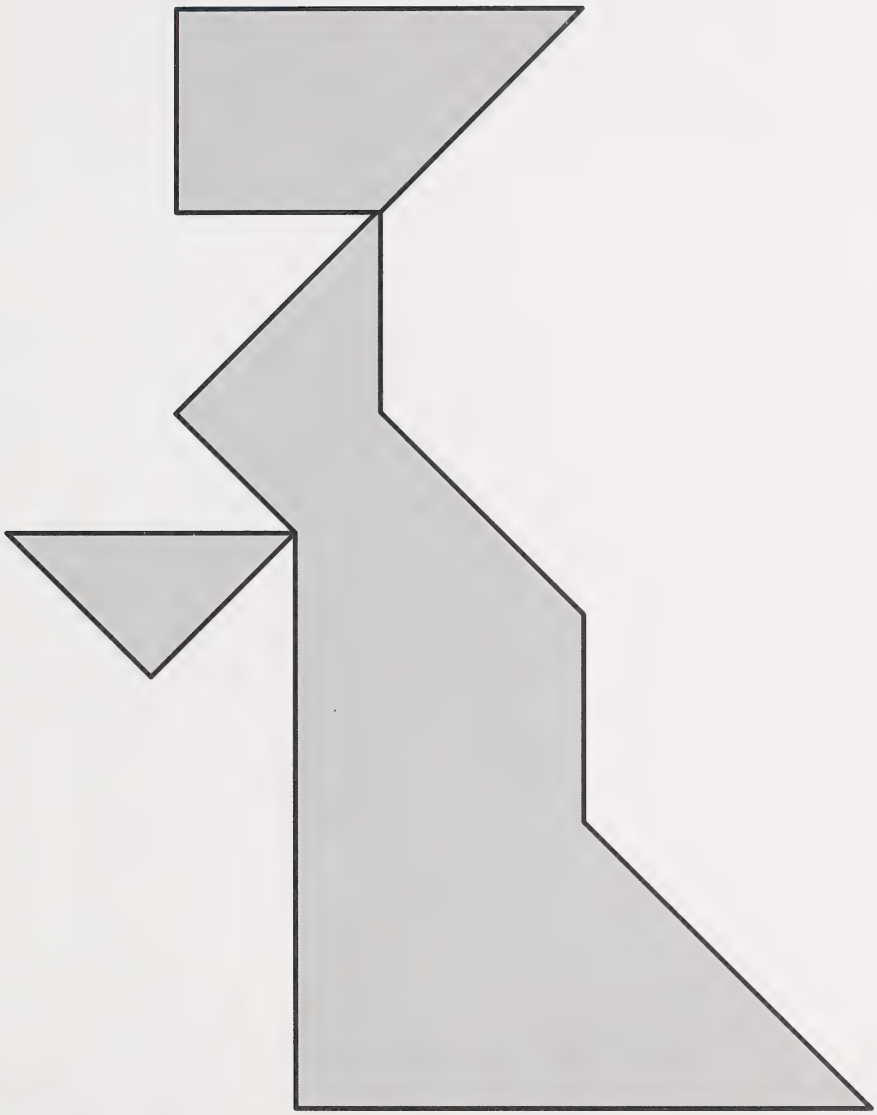
Tangram Puzzle

Man



Tangram Puzzle

Woman



Hexominoes

Use the 2-cm grid paper to make as many different shaped hexominoes as you can.

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